



SPECIMEN LABEL
42% REDUCTION

464-353
Comment

DOWICIL^{*}

S 13

ANTIMICROBIAL AGENT

An antimicrobial for formulating use and for use in the manufacture of paint, paint coatings, wood, joint cement and caulking, and related materials to control fungi and bacteria.

Active Ingredients 90%
 2,3,5,6-Tetrachloro-4-(Methylsulfonyl)-pyridine 82%
 Other chlorinated pyridines 8%
 Inert Ingredients 10%
 E.P.A. Registration No. 464-1-1 AA E.P.A. Est. 464 CA 1

WARNING
 MAY CAUSE EYE DAMAGE - CAUSES SKIN IRRITATION
 HARMFUL IF SWALLOWED
 Do Not Get in Eyes - Avoid Contact with Skin

NOTE: Refer to directions in Technical Bulletin for DOWICIL S13 ANTIMICROBIAL before Handling or Using.

LOT

NOTICE

Do not re-use empty container. Destroy it by burying it with waste or by burning it. Stay away from smoke or fumes.

This product is toxic to fish. Treated effluent should not be discharged where it will drain into lakes, streams, ponds, or public water. Do not contaminate water by cleaning of equipment or disposal of waste.

40 LB/18.14 KG

THE DOW CHEMICAL COMPANY

AND SUBSIDIARIES

MIDLAND MICHIGAN 48640 USA ZURICH SWITZERLAND HONG KONG B.C.C.
CORAL GABLES FLORIDA 33134 USA SARNIA ONTARIO CANADA

PRINTED IN U.S.A. IN OCTOBER, 1974.

REPLACES SPECIMEN LABEL PRINTED IN JUNE, 1974.

ACCEPTED WITH COMMENTS

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WARNING

**MAY CAUSE EYE DAMAGE • CAUSES SKIN IRRITATION
HARMFUL IF SWALLOWED
Do Not Get in Eyes • Avoid Contact with Skin**

In case of contact immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention. Wash skin with soap and plenty of water.

NOTE: Refer to directions in Technical Bulletin for DOWICIL S 13 ANTIMICROBIAL before Handling or Using.

LOT

NOTICE

Seller warrants that the product conforms to the chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty, nor any other warranty, of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions or under abnormal conditions, or under conditions not reasonably foreseeable to the seller at the time of sale of the product.

U.S. Pat. No. 3,296,072

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40 LB/18.14 KG

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CORAL GABLES, FLORIDA 33134, USA SARNIA, ONTARIO, CANADA

• Trademark of THE DOW CHEMICAL COMPANY

PRINTED IN U.S.A. IN OCTOBER, 1974.

How DOW Antimicrobials Serve the Paint Industry

Controlling mold and bacterial growth in paint formulations and applied paint films is one of the most persistent problems faced by the paint industry.

All paints contain materials which permit microbiological growth. Water-extendable paints usually incorporate natural or synthetic thickeners, emulsifiers, and dispersing agents which, unless suitably protected, are readily attacked by microorganisms while the paint is in storage. Such attack markedly affects the viscosity, stability, and performance of the product and can generate sufficient gas to explode paint cans. Applied latex paint films likewise support or allow the growth of mold, which causes unsightly surface discoloration and eventually destruction of the film.

Oil-based paints are relatively immune to spoilage during storage. However, the oils, resins and modifiers which they contain can be attacked after the film has dried, with the same undesirable results as with latex paints.

DOW ANTIMICROBIALS EFFECTIVELY AND ECONOMICALLY PREVENT MICROBIAL GROWTH IN BOTH STORED PAINTS AND APPLIED FILMS. THESE PRODUCTS:

- Have high antimicrobial efficiency.
- Do not affect the film characteristics or drying time of the paint.
- Show persistent activity.

This bulletin discusses the use of Dow antimicrobials as paint ingredients and for maintaining general plant sanitation. For further information on the toxicology and procedures for handling these antimicrobials safely, contact The Dow Chemical Company, Designed Products Department, 2040 Dow Center, Midland, Michigan 48640, or your Dow sales representative.

Comment

ACCEPTED

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UNDER THE TERMS OF THE DOW PRODUCT LIABILITY AGREEMENT, THE FOLLOWING PRODUCT IS BEING REVIEWED FOR COMPLIANCE WITH THE FEDERAL FOOD, DRUG, AND COSMETIC ACT AND THE FEDERAL INSECTICIDE ACT.

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FACTORS AFFECTING MOLD GROWTH IN APPLIED FILMS

Five major factors affect the susceptibility of paint films to mold growth: (1) conditions of exposure, (2) the substrate over which the paint is applied, (3) the susceptibility to attack of the film formers and additives in the system, (4) pigmentation, and (5) the physical properties of the film.

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Continued

THE DOW CHEMICAL COMPANY warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with the directions for use. This warranty, however, does not extend to the use of this product in any other manner or for any other purpose. THE DOW CHEMICAL COMPANY does not warrant the fitness of this product for any particular purpose, express or implied, or for any use not intended by the manufacturer. THE DOW CHEMICAL COMPANY does not assume any responsibility for any loss or damage caused by the use of this product, or for any loss or damage caused by the use of this product in any manner not intended by the manufacturer. THE DOW CHEMICAL COMPANY does not assume any responsibility for any loss or damage caused by the use of this product in any manner not intended by the manufacturer.

The level of humidity to which a paint film is exposed greatly influences mold development. In high-humidity environments, mold grows very easily and abundantly on unprotected paints. Where humidity is moderate, mold does not pose so great a problem. Nevertheless, short periods of particularly favorable conditions may occur in almost any area of the country. These provide sufficient time for mold to gain a foothold and do some damage to the paint.

The problems of mold control are much more severe when paint is applied over a wood substrate than when it is applied over masonry. The type of wood likewise has a bearing on ease of control, i.e., paints over yellow pine are more susceptible to attack than paints over redwood.

Oil paint films are more susceptible to mold growth than are latex paint films, yet when applied over a nutritive substrate, the latex film presents a much more severe mold control problem.

Most of the pigments used in paints have no effect on mold growth. A few, such as carbon black and some bone blacks, serve as nutrients for mold, while others, such as zinc oxide and pigments containing mercury and copper, do inhibit mold growth somewhat. However, the practicality of the latter as mold control agents is limited because of the mildness of their inhibiting properties, their cost, or their color.

The rate at which a paint film dries and the degree to which it hardens also influences its susceptibility to contamination. A paint that dries slowly is the most easily contaminated because of the longer period of time in which mold spores and air-borne nutrients may be trapped by the tacky surface. The dust and organic matter which accumulate on dried paint films may nurture the growth of mold. Such accumulations may contain abrasive material that scratches the film and allows the mold to make a start more easily. Harder surfaces minimize scratching.

Although mold resistance may be improved by use of the proper driers and pigments, the resistance will not be sufficient to prevent growth under many conditions. Adding a fungicide to the formulation is the only sure way to guard against mold growth and the problems following in its wake. To obtain meaningful performance data, the fungicide must be tested in the actual paint formulations to be protected, over the range of substrates to be painted, and under actual use conditions.

PLANT SANITATION

The successful use of Dow antimicrobials is greatly dependent on a product low in contamination. Hence the practice of good plant sanitation is of utmost importance.

To maintain proper plant sanitation the following practices should be carried out:

At frequent intervals, clean and disinfect all mixing and processing equipment, pipelines, and holding tanks for the paint, and make frequent checks for bacterial contamination in the storage tanks for raw materials used in water-base paints.

Prepare only minimum working quantities of decomposable materials.

Add enough of the antimicrobial to any raw material for water-base paint at the point of manufacture to provide sufficient protection against contamination until the material is used in the paint system.

A 1% solution of DOWICIDE® A Antimicrobial is suggested for disinfecting storage tanks and processing equipment. The tank or equipment should be washed free of residues and then rinsed with the solution. Leave this solution on the surface; do not rinse with plain water.

DOWICIDE A Antimicrobial or DOWICIDE G Antimicrobial, a 50-50 mixture by weight of the two, or DOWICIL® 100 Antimicrobial should be used to preserve solutions or dispersions of decomposable raw materials which are to be stored before they are added to the paint formulation. The proper concentration of antimicrobial must be determined for each individual substrate to be preserved. Without a preservative, these mixtures may become heavily contaminated with bacteria, molds and their enzymes, which in turn will contaminate the product and cause problems.

USE IN LATEX PAINTS

Dow offers manufacturers of latex paint three categories of paint preservatives, each with its own particular area of greatest utility.

DOWICIDE antimicrobials are most effective for the shelf preservation of protein-base latex paints and their films. They exhibit complete compatibility at the alkaline pH levels encountered during formulating and in the finished product.

DOWICIL 100 Antimicrobial is most effective for the shelf-preservation of cellulose-thickened latex paints.

DOWICIL S-13 Antimicrobial is most effective where exterior or interior latex films with a high degree of resistance to mold growth are required.

DOWICIDE Antimicrobials

Formulators of protein-base paints should utilize a 50-50 mixture of DOWICIDE A and DOWICIDE G at a minimum concentration of 0.6% based on wet formulation weight, or a 50-50 mixture of DOWICIDE 1 and DOWICIDE 7 at a minimum concentration of 0.5%. The type and exact concentration of the antimicrobial mixture will depend upon the facilities of the formulator and the nature of the formulation. The antimicrobial should be added as early as possible during the manufacturing operation, in order to prevent bacteria from building up during the formulating period.

The mixture of DOWICIDE A and DOWICIDE G antimicrobials should be added to the formulation from a water solution to assure uniform distribution. These antimicrobials are water-soluble sodium salts and can be made into fairly concentrated solutions. DOWICIDE A is sufficiently soluble to yield a 50% solution, and a 20% solution of DOWICIDE G is practical.

Where effluorescence is a problem, the potassium analogues of DOWICIDE A and DOWICIDE G can be easily prepared from DOWICIDE 1 and DOWICIDE 7 antimicrobials, respectively, for addition as a water solution, or the DOWICIDE 1 and DOWICIDE 7 can be incorporated as solutions in water-miscible solvents. Directions for preparing the potassium salts can be obtained from Dow.

DOWANOL[®] PM glycol ether is an excellent solvent for DOWICIDE 1. DOWANOL P-Mix glycol ether is an excellent solvent for DOWICIDE 7. One lb. of DOWANOL PM will dissolve 1 lb. of DOWICIDE 1 and 1 lb. of DOWANOL P-Mix will dissolve 1.67 lb. of DOWICIDE 7. When these antimicrobials are added to the formulation in glycol ether solvents a drop in pH will occur. This must be compensated for by adding sufficient alkaline agent to adjust to the proper pH for the system.

To minimize the introduction of water or solvent into the paint formulation, only the most highly concentrated solutions of DOWICIDE antimicrobials should be utilized. These should be stored at room temperature and in closed containers.

DOWICIL 100 Antimicrobial

Cellulose-base latex paints are effectively protected by 0.1–0.2% by formulation weight of DOWICIL 100 Antimicrobial. Do not use DOWICIL 100 in casein-containing systems.

Effective levels were established by insulating paints containing various levels of DOWICIL 100 with a mixture of 11 strains of organisms isolated from spoiled latexes and latex paints, incubating the paint samples at 30 C for 24 hr, streaking the paint on nutrient agar in petri dishes, incubating the plates under the same conditions as the paint samples, and examining them for the presence of organisms. Paints containing the above level of antimicrobial were able to undergo 10 such cycles without producing growth on plates. In the same type of test, the antimicrobial prevented spoilage through five cycles at 140 F for one week, while protected paint which has been shelf-aged for one and two years produced no growth, when insulted and streaked in the same manner.

Accelerated aging tests at 140°F and freeze-thaw stability tests of five cycles (15 hr at 15°F and 9 hr at 75°F) showed negligible effects on the viscosity and stability of paint systems. A pH drop of 0.2-0.4 developed.

Exposure to north and south light for 1-1.5 years produced no discoloration in latex paint films containing 0.1, 0.2, and 0.3% of antimicrobial.

DOWICIL 100 Antimicrobial is highly soluble in water, and solutions of 25% by weight can be readily prepared at room temperature or below.

The point of addition of DOWICIL 100 to the paint is not critical. It may be incorporated either as a dry material or as a solution during any phase of the paint-making operation or with most of the water soluble raw materials of the formulation.

DOWICIL S-13 Antimicrobial

This product effectively inhibits mold growth on interior and exterior latex paint films which require a high degree of protection.

To provide the most effective inhibition, DOWICIL S-13 should be added to both the primer and the top coat. Complete control can generally be obtained in exterior exposure with 0.5-1.0% of material. When paints formulated to a high pH are stored for prolonged periods under ordinary storage conditions, the effectiveness of the antimicrobial may decrease due to hydrolysis. This effect is most pronounced in acrylic systems. DOWICIL S-13 in paints formulated in the pH 7-8 range has shown no deterioration or loss of performance upon shelf-aging of the paints for periods up to 2.5 years.

DOWICIL S-13 Antimicrobial is only very slightly soluble in water but moderately soluble in many organic solvents. Its low water solubility enhances mold control in applications where persistent inhibition of fungal growth requires a slow sacrifice of the antimicrobial.

Dispersion of DOWICIL S-13 is best accomplished by grinding the antimicrobial with the pigments. It can also be added as pre-dispersed slurry consisting of 25 parts antimicrobial, 74 parts ethylene glycol, and 1 part of a suitable nonionic surfactant.

USE IN OIL PAINTS

DOWICIDE Antimicrobials

The paint industry has for many years utilized DOWICIDE 6 to control mold on oil paint films. This product offers manufacturers a number of highly desirable properties. It is soluble in most organic solvents, has high fungicidal efficiency and a relatively low vapor pressure. Paint formulations containing it dry in the same length of time as untreated paints and the characteristics of the films are substantially the same. When the paint is sprayed, a mist may be formed which should not be breathed. However, an ordinary spray painter's respirator will usually provide adequate protection.

The level of antimicrobial required in a formulation depends upon the humidity of the environment in which it will be used. In severe mold areas, levels up to 3% will be required.

In most instances, the oils and thinners used in the vehicle are good solvents for the antimicrobial; consequently, it can be dissolved in these solvents and dispersed throughout the formulation. If the antimicrobial is not sufficiently soluble in these components it can be ground with the pigment or dissolved in a solvent compatible with the system and added as a concentrate.

NOTE: DOWICIL S-13 is not cleared for use in paint that will be used in food processing areas.

DOWICIL S-13 Antimicrobial

This product provides effective protection against molding of oil-base paint films. It should be added to the formulation by dispersion with the pigment. In paints for exterior applications, it is generally used in combination with zinc oxide pigment. The levels required may vary from 0.25 to 0.5% in paints with high zinc oxide loading to 1 to 3% in zinc-oxide-free systems. For interior paints, levels of 0.3 to 0.7% are required, the lower range for flat finishes and the higher one for gloss paints.

USE IN LACQUERS AND INDUSTRIAL FINISHES

DOWICIL S-13 Antimicrobial

DOWICIL S-13 Antimicrobial is utilized in a number of factory-applied finishes. The product exhibits low volatility at temperatures up to 250°C and does not discolor during the drying operation. Because of the great variations which can exist in formulations and in the substrates and environments where the formulations are used, each application for the antimicrobial must be evaluated separately.

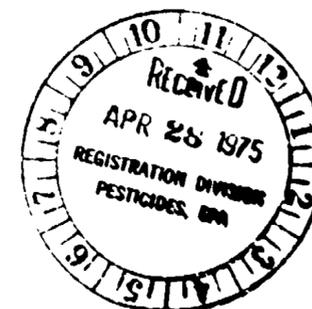
APPLYING MOLD-RESISTANT PAINTS

In order for mold-resistant paints to provide maximum protection, the surface to be painted must be free from mold contamination. If paint is applied to a surface where mold is growing, growth is likely to continue beneath the new paint film. Visible damage soon follows. The surface should be cleaned with a soap or detergent solution and then disinfected.

FURTHER INFORMATION

Further information concerning DOW Antimicrobials can be obtained by writing The Dow Chemical Company, Designed Products Department, 2040 Dow Center, Midland, Michigan 48640 or your Dow sales office.

WARNING: These antimicrobials may present hazards in handling and use. Observe all precautions given on the product labels and in the product literature.



ANTIMICROBIAL AGENTS

SECTION I-15
DOWICIL
S-13 Antimicrobial

DOWICIL* S-13 ANTIMICROBIAL

GENERAL

DOWICIL S-13 Antimicrobial is Dow's designation for 2,3,5,6-tetrachloro-4-(methylsulfonyl)pyridine.

This product is an organic chemical compound possessing a high degree of antifungal activity. The chemical has the desirable properties of:

- low water solubility
- high melting point
- low vapor pressure

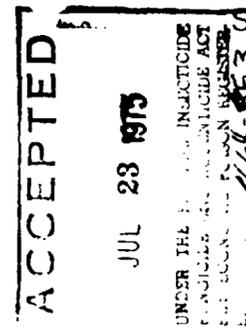
These properties enable DOWICIL S-13, when used properly, to provide antifungal properties to substrates subject to adverse environmental conditions for extended periods of time.

DOWICIL S-13 Antimicrobial can be incorporated into substrates such as paint, paper coatings, wood, joint cement and caulking, and related materials.

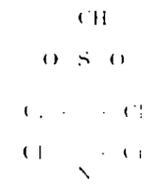
PHYSICAL PROPERTIES

(Laboratory results typical of the product, but not to be confused with, or regarded as, specifications).

Comment



Structure:



Formula	C ₅ H ₃ Cl ₄ SO ₂ CH ₃
Molecular Weight	294.96
Melting Range, °C	141-143
Bulking Factor gal/lb	0.0642
Bulk Density Range lb/ft ³	24-26

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NOTICE: It is the policy of Dow Chemical Company to provide information on the products it manufactures. This information is intended to assist you in your selection of the most suitable product for your needs. It is not intended to constitute an offer of insurance or any other financial product. For more information, contact your local Dow Chemical Company representative.



THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN 48640

PHYSICAL PROPERTIES—continued

Solubility, [†] approx g/100 g solvent at 25°C		DOWANOL* PM (propylene glycol methyl ether).....	>4
Dimethylformamide	34.3	Methanol	2
Acetone	22	Mineral spirits	< 0.5
Methylethyl ketone	18	n-Butyl alcohol	> 0.5
Methylene chloride	7	Perchloroethylene	< 0.5
Benzene	5	Kerosene	0
Ethylene dichloride	5	Water	25 ppm
Toluene	5		
Xylene	5		

[†] Refers to solubility of active ingredients only

SALES SPECIFICATIONS

Description	Off-white, free- flowing powder.
Active Ingredients:	
2,3,5,6-Tetrachloro-4-(methylsulfonyl) pyridine	82%
Other chlorinated pyridines	8%
Inert Ingredients	10%
Anti-caking agent, max.	1.5%

Methods of analyses for these items may be obtained from The Dow Chemical Company, Designed Products Department, 2040 Dow Center, Midland, Michigan 48640.

E.P.A. Registration No. 464-353.

ANTIMICROBIAL EFFICIENCIES

Organism	Concentration Required to Inhibit Growth (ppm)
BACTERIA	
<i>Aerobacter aerogenes</i>	500
<i>Bacillus subtilis</i>	100
<i>Pseudomonas aeruginosa</i>	500
<i>Salmonella typhosa</i>	50
<i>Staphylococcus aureus</i>	5
FUNGI	
<i>Aspergillus terreus</i>	1
<i>Candida pelliculosa</i>	50
<i>Pullularia pullulans</i>	10
<i>Rhizopus nigricans</i>	10
<i>Lenzites trabea</i>	5
<i>Aspergillus niger</i>	10
<i>Trichoderma</i> sp.	50
<i>Penicillium digitatum</i>	20
<i>Cephalosporium fragans</i>	0.5

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APPLICATIONS

This product is registered with the Pesticides Registration Division for manufacturing use only (E.P.A. Regist. No. 464-353). Dow will authorize E.P.A. to refer to the information in this registration file, on a confidential basis, in consideration of customers' applications for registrations of new antifungal coatings and/or other products containing DOWICIL S-13. Customers may direct their requests for such authorization to the Registration Section, Ag-Organics Department, The Dow Chemical Company, Building 9008, Midland, Michigan 48640.

DOWICIL S-13 may be used as a preservative for food packaging adhesives under provisions of the Federal Food, Drug, and Cosmetic Act per CFR 121.2520.

Use Area	Concentration of Antimicrobial
Caulking	0.25 — 1.0%
Grouting	1.0 — 2.0%
Joint Cement	0.1 — 0.5%
Paint: ¹	
Latex (water based)	0.5 — 1.0% ²
Oil or Alkyd	0.25 — 3.0% ³
Varnish	0.25 — 1.0%
Rope Preservative	0.5 — 1.0%
Wood Preservative	0.5 — 2.0%
Prefinished ceiling tile	0.25 — 1.0%
Soap wrapping	0.2 — 1.0%
Coated Paper	0.25 — 1.0%

¹NOTE: DOWICIL S-13 is not cleared for use in paint that will be used in food processing areas.

²Concentration is dependent on extent of mildew problem in geographical area. Heavy mildew areas require 1.0%.

³Concentration is dependent upon extent of mold problem and level of zinc oxide in paint. All paints should be tested in geographical area of exposure prior to selecting a level of use.

Caulking Compounds

DOWICIL S-13 has been found to be effective at levels of 0.24-1.0% in both architectural and bathroom caulks. The addition level is dependent upon the level of mold control desired in the end product and the environmental conditions to which the caulk is subjected.

Wood Protection

DOWICIL S-13 has been found to be effective in the laboratory against known wood decay organisms. It is currently being tested in a stake test plot in Florida. Four year results from this test plot indicate excellent protection against termites and other wood-decay organisms. DOWICIL S-13 has also been used in a treatment similar to pentachlorophenol "Wood Life"[†] treatment. The application of this formulation of DOWICIL S-13 to bare wood followed by an unpreserved coat of paint has been offering protection against mold growth for as long as five years in the Gulf Coast area.

Adhesives

DOWICIL S-13 can be used at levels of 0.25-1.0% to obtain protection of these substrates against mold formation. The length of protection desired and the particular environmental conditions to which the substrate will be subjected are again the conditions which will dictate the level necessary in a particular system.

Paper

DOWICIL S-13 can be incorporated into paper coatings to provide mold protection to the paper substrate. One application in this area would be for soap wrappers. Because of the high activity of DOWICIL S-13 against microorganisms known to attack paper, the applications are usually investigated and evaluated on an individual customer basis.

FEDERAL PAINT SPECIFICATIONS

A number of the TT-P Federal Specifications for paint require the paint to pass a fungicide test, usually an agar plate-filter paper type test. DOWICIL S-13 will pass this type of test before and after water leaching at levels between 0.2 and 0.3% for latex-based paints, and between 0.5 and 1.0% for oil-based paints. Dow laboratories are available for testing paints according to the various specifications.

Other Applications

The above applications are only some of the areas where this highly effective antimicrobial can be used. Any applications involving the exposure of a substrate to adverse environmental conditions is a potential application for this product. The services of our laboratory are available for evaluating and testing such applications.

HEALTH HAZARDS, PRECAUTIONS FOR SAFE HANDLING, FIRST AID MEASURES

The following statements are necessarily general in nature since the circumstances associated with the use of the product are unknown and beyond Dow's control. Suggestions regarding the hazards likely to be encountered in specific operations will be made upon request whenever possible. Address inquiries to The Dow Chemical Company, Designed Products Department, 2040 Dow Center, Midland, Michigan 48640.

Health Hazards

Direct contact of DOWICIL S-13 Antimicrobial with the eyes can cause severe conjunctival and corneal injury if the eyes remained unwashed. Skin contact (strong solutions particularly) can produce mild to moderate skin irritation. Dusts, if breathed, are capable of producing mild to moderate irritation of the upper respiratory tract. Delayed hypersensitivity has occurred in some people.

Precautions for Safe Handling

Eye protection, such as goggles, should be worn when this product is handled. A dust respirator approved for use with toxic dusts should also be worn. Gloves and coveralls are recommended. Contaminated clothing should be laundered before re-use.

Face, hands, and other exposed areas of the skin should be thoroughly washed before eating, drinking, or smoking. Showering after working with the material is another good practice.

First Aid Measures

Eye contact - Contaminated eyes should be flushed with plenty of flowing water and prompt medical attention should be obtained.

Skin contact - Contaminated areas of the skin should be washed with soap and plenty of water. Any irritation which develops should receive medical attention.

Inhalation - If any illness or injury occurs from the breathing of this material, the person should be removed to fresh air and kept warm and quiet. Medical attention should be obtained.

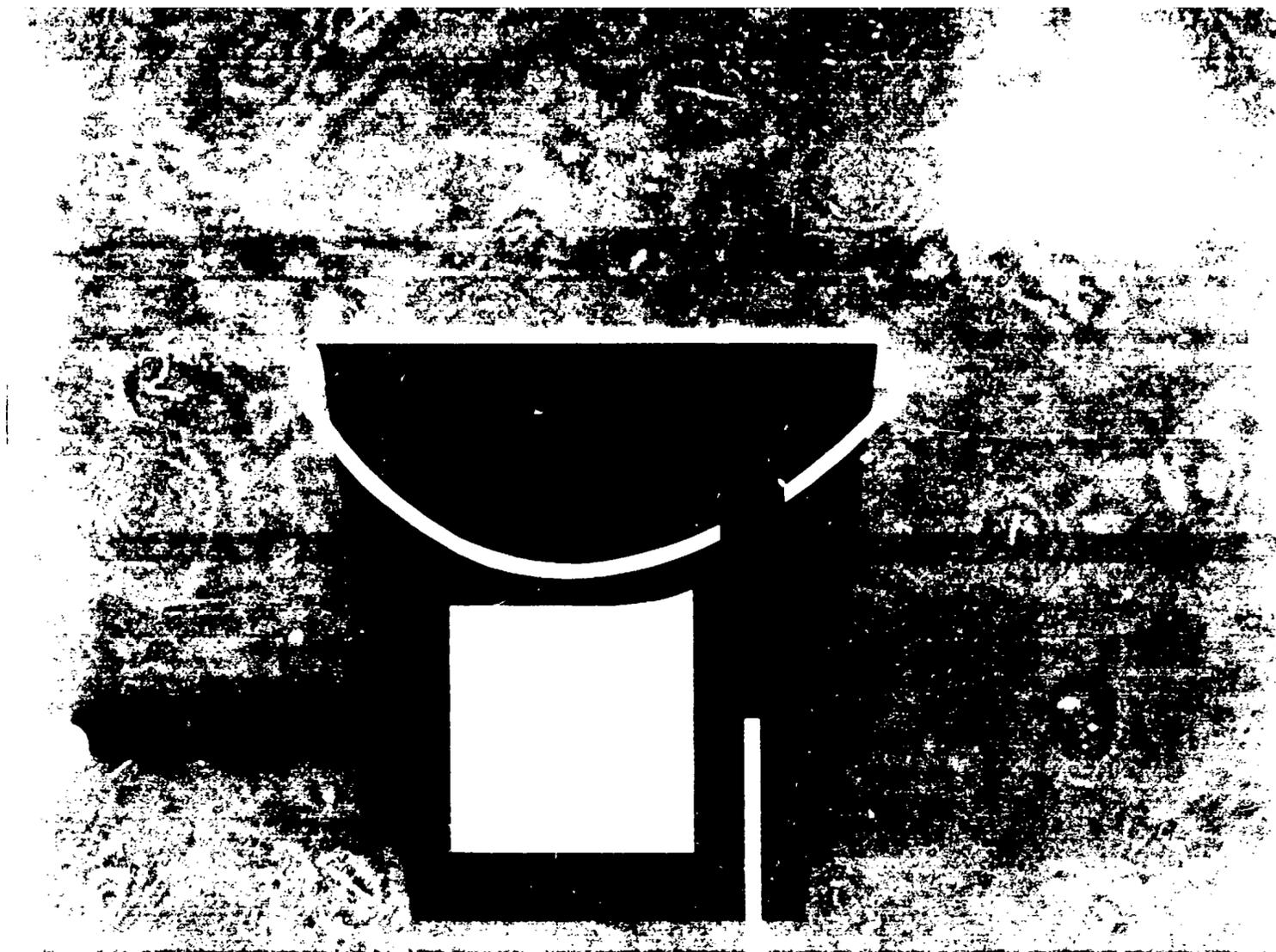
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Fish and Wildlife Precaution

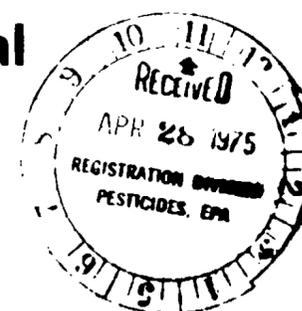
This product is toxic to fish. Treated effluent should not be discharged where it will drain into lakes, streams, ponds, or public water. Do not contaminate water by cleaning of equipment or disposal of wastes.

FURTHER INFORMATION:

Further information concerning DOWICIL S-13 can be obtained by referring to the special bulletin on DOWICIL S-13 for the Paint Industry and writing The Dow Chemical Company, Designed Products Department, 2040 Dow Center, Midland, Michigan 48640 or your Dow sales office.



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for the Paint Industry**



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The information on this page is for informational purposes only. It is not intended to be used as a substitute for professional advice.

DOWICIL S-13 Antimicrobial

in the Paint Industry

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Man is faced with a continual battle against microorganisms such as bacteria and fungus. Some of these are useful, but others cause disease and can damage the goods of industry. One particular class of fungus, mold, can be detrimental to paint, plastic, rope, wood, and fabrics. Concern about the destruction caused by fungi prompted our search for products particularly effective against these microorganisms.

Observations concerning the fungicidal activity of a class of pyridine-based compounds were first made at Dow in the early 1960's. Shortly thereafter laboratory and field results indicated several materials had outstanding activity in various coatings against mold growth. Additional tests were conducted and these results coupled with very favorable toxicological properties encouraged the development and eventual commercialization of DOWICIL S-13 Antimicrobial, the Dow brand name for 2,3,5,6-tetrachloro-4(methyl sulfonyl) pyridine.

This bulletin concentrates on the use of DOWICIL S 13 Antimicrobial in the Paint Industry.** Other uses are in caulking compounds, paper, adhesives and for wood protection. (See Section I-15 of the Dow Antimicrobial notebook.) For further information, see the special bulletin "Precautions for Handling Dow Antimicrobials" or contact Designed Products Department, The Dow Chemical Company, 2040 Dow Center, Midland, Michigan 48640, or your nearest Dow office.

DOWICIL S-13 Antimicrobial has a high degree of fungus resistance. This chemical also has the desirable properties of:

- Low Water Solubility
- High Melting Point
- Low Vapor Pressure
- Favorable Order of Mammalian Toxicity

Those properties make it possible to use DOWICIL S-13 Antimicrobial as a fungus-resistant agent in substrates subjected to adverse environmental conditions for extended time periods, and to use it (see Handling Precautions, page 8) in applications where human contact may occur with these substrates.

NOTE: DOWICIL S-13 is not cleared for use in paint that will be used in food processing areas.

Chemical and Physical Properties

Formula	C ₅ NCI ₄ SO ₂ CH ₃
Molecular Weight	294.96
Melting Range	141-143 C
Bulking factor (gallons/pound)	0.0642

Solubility, approximate, gm/100 gm solvent at 25°C

Kerosene	0
Water	(25 ppm)
Perchloroethylene	< 0.5
n-Butyl Alcohol	< 0.5
Mineral Spirits	< 0.5
Methanol	2
DOWANOL [®] PM propylene glycol methyl ether	4
Xylene	5
Toluene	5
Ethylene Dichloride	5
Benzene	5
Methylene Chloride	7
Methylethyl Ketone	18
Acetone	22
Pyridine	35
Dimethylformamide	34

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Heat Stability (Heating rate — 10°C/minute)

Temperature	% Weight Loss in Air
60°C (140°F)	0.2
120°C (248°F)	0.5
180°C (356°F)	1.2
240°C (464°F)	5.8
300°C (572°F)	39.5

Antimicrobial Efficiencies

Microorganism	Concentration Required to Inhibit Growth (ppm)
BACTERIA	
<i>Aerobacter aerogenes</i>	500
<i>Bacillus subtilis</i>	100
<i>Pseudomonas aeruginosa</i>	500
<i>Salmonella choleraesuis</i>	50
<i>Salmonella typhosa</i>	50
<i>Staphylococcus aureus</i>	5
<i>Desulfovibrio desulfuricans</i>	10
<i>Proteus mirabilis</i>	100
FUNGI	
<i>Aspergillus terreus</i>	10
<i>Candida pelliculosa</i>	50
<i>Lenzites trabea</i>	5
<i>Phoma sp.</i>	10
<i>Aspergillus niger</i>	4
<i>Pullularia pullulans</i>	10

Trade Sales Paints

Mold attacks painted surfaces resulting in an unattractive and dirty appearance. Dirt and organic matter are easily trapped in the web-like mold structure and supply more nutrient resulting in a more luxurious growth. Deterioration of the paint film can result when the mold penetrates the coating in its search for nutrient necessary for metabolism.

DOWICIL S-13 Antimicrobial will dramatically reduce mold growth when added

to acrylic, vinyl acetate, and oil based paint. Extensive testing at our Freeport, Texas, Test Fence Site and on homes in the Gulf Coast area have convinced us of the persistence and effectiveness of DOWICIL S-13. The use level recommended for two year mold free protection in high mold areas like the Gulf Coast is 10 pounds per 100 gallons. Lower levels around 4-5 pounds per 100 gallons have provided equivalent protection in northern climates and less mold susceptible areas.

Systemic fungicides are not recommended for use on exterior surfaces.

Industrial Paints

Industrial maintenance paints are a natural for this product. Tropical Chamber tests, reported below, indicate that levels

as low as 0.3% provide mold protection in high temperature, high humidity environments. These conditions are quite common in food processing and dairy plants.

Paint System	Addition Level ¹ for DOWICIL S-13	Rating ²				
		14 Days	28 Days	42 Days	56 Days	70 Days
PVA ³	0	NN	TT	SS	HM	HH
	3	NN	NN	NN	TT	TS
	4	NN	NN	NN	TT	TT

¹ Addition levels in pounds per 100 gallons of paint.

² Ratings: N - No mold growth, T - 5% coverage of panels, S - 25% coverage, M - 25-75% coverage, H - 75% coverage. (Duplicate panels are run to minimize substrate variation, triplicates are also run occasionally.)

³ Polyvinyl acetate - pH = 7.6

The exposure conditions in the tropical chamber are as follows:

1. 90% Relative Humidity
2. 86 F
3. Complete absence of light
4. Circulating air insures continuous inoculation of the panels by naturally occurring fungi thriving in the chamber.

The chamber is not considered equivalent to outdoor exposure since sunlight and intermittent rainfall is absent. The

test is considered a screening technique to rapidly (30-60 days) determine the relative effectiveness of film preservatives. Normally, a paint film absorbs 20% moisture (high temperature, high humidity area such as the Gulf Coast). In the chamber, the film may absorb as high as 30-40% of its weight in moisture. It is an accelerated laboratory mold test and provides more conclusive data about relative effectiveness of various preservatives than agar plate tests.

Local and Federal Government Regulated Paints

Federal specification paints which must pass certain bioactivity tests will do so even with quite low levels of DOWICIL S-13 (see Table)

Federal Specification	Paint System	Addition level of DOWICIL S-13 to pass test
TT-P-650 b	Latex base, interior white	0.3%
TT-P-0029	All	0.2-0.3%
TT-P-55 b	Polyvinyl acetate exterior	0.3%

Lower levels than those quoted above will pass the specific tests but we recommend the levels given in the table. Other local government requirements such as the New York City Housing Authority

Material 25 and the Connecticut Lead Paint Act (January 1, 1970) can be met with DOWICIL S-13. Additional testing of DOWICIL S-13 will be done for other specific applications upon request.

Latex Emulsion Paints

Dispersion of DOWICIL S-13, an organic crystalline solid, is best accomplished by grinding the antimicrobial with the pigments. Uniform dispersions have been obtained utilizing the Cowles Dissolver, Morehouse Mill, and Pebble Mill. It can also be added during the letdown operation as a pebble-milled slurry consisting of 25 parts DOWICIL S-13, 74 parts ethylene glycol, and 1 part of a suitable nonionic surfactant.

The pH sensitivity of DOWICIL S-13 is a factor in using the product in latex paint. The chemistry involved in this sensitivity is actually a hydrolysis reaction. The CH₂SO₂ group attached to the tetra chloropyridine portion of the molecule is, in effect, replaced with a -OH group. The resulting product is a pyridinol compound which does not have the same activity against mold as DOWICIL S-13.

Despite the hydrolysis problem, DOWICIL S-13 Antimicrobial is the most effective mold control agent that has ever been made available to the paint industry. The amount and persistence of mold control activity provided by DOWICIL S-13 on a customer's house, however, depends on the length of time the paint is in distribution between the production plant and the customer and the severity of the paint environment on the stability of DOWICIL S-13. Its utility, therefore, depends on the ability of the customer to control these two conditions.

DOWICIL S-13 Antimicrobial has the best stability in a latex system when formulated at pH near neutral or slightly alkaline. Latex systems containing DOWICIL S-13 formulated in a pH range

of 7.0 to 8.0 show significantly better retention of DOWICIL S-13 upon aging than latex systems formulated above pH 8.0. Eighty to ninety percent of the total amount of DOWICIL S-13 added to polyvinyl acetate paint formulated at a pH of 7.0 to 8.0 and aged 2 1/2 to 3 years on the shelf has been recovered. This shelf aging can be simulated with a six week accelerated oven test at 120 F. In a latex system formulated above pH 8.0, it is not uncommon to see a 50% loss of product after a one-year shelf aging or following three weeks' accelerated aging at 120 F.

Addition of various organic amine stabilizers¹ such as morpholine, triethanolamine, and diethanolamine has an adverse effect on the stability of DOWICIL S-13 in all latex systems tested. The break-down is fairly rapid and extensive even at room temperature storage. Organic amines are sometimes incorporated to improve compatibility with universal colorant systems. They should be avoided if DOWICIL S-13 is to be used in a latex paint. Adjustments in pH should be made with ammonium hydroxide.

Stability of DOWICIL S-13 in an acrylic system can be evaluated with our laboratories and is definitely advisable before the product is utilized in production.

In most latex systems tested, whether by tropical chamber evaluation or by test fence exposure in Freeport, Texas, DOWICIL S-13 Antimicrobial has provided significantly improved mold resistance over identical systems containing any of the commercially available fungicides. These results were obtained despite shelf aging up to a year or more or accelerated aging at 120 F for periods of six weeks. In the most adverse systems tested for stability of DOWICIL S-13, the amount of mold control provided after extended aging of the paint had met or gone far as that provided by any other fungicide.

Oil Based Paints

DOWICIL S 13 containing zinc oxide provides excellent protection to oil based paint films from mold growth formation. The painting method should follow the type dispersion or dispersion with the pigments.

Combinations of DOWICIL S 13 and zinc oxide will provide good film preservation for DOWICIL S 13 will provide protection to the paint film particularly in shaded or protected areas of a house. The levels recommended can vary from 1.0 to 2.75% in high zinc oxide containing paints to 1.15% in low zinc systems.

Industrial Finishes

DOWICIL S 13 Antimicrobial can be used in a number of factory applied finishes. The product has low volatility at temperatures up to 250°C and does not discolor during the drying operation. Because of the great variations which can exist in formulations and in the substrates and environments where the formulations are used, each application for the antimicrobial must be evaluated separately. Some of the areas where the product can be used effectively are: Coatings for Plywood and Marine Density Board, and Coatings for Industrial Construction Products.

It is most resistant to attack to provide maximum protection. The surface to be painted must be free from mold contamination. If paint is applied to surfaces which mold has or will grow on, the mold will continue to attack the surface and cause visible damage to the finish. The surface should be clean and free of dirt or other particles which may be present.

The National Paint and Varnish Association recommends a formulation which has been found to be satisfactory by many contractors. It uses Trisodium phosphate (Sax brand for example) 1 ounce per quart (1/2 sodium hypochlorite (Clorox brand for example) and 3 quarts warm water or enough to make one gallon. Use this solution without diluting to remove mold and dirt. Best results are obtained by scrubbing with a medium soft brush. When the surface is clean, rinse thoroughly with fresh water from a hose. After allowing the surface to dry, a paint containing DOWICIL S 13 Antimicrobial will provide excellent protection against further mold formation.

Toxicological Properties

The toxicological properties of DOWICIL S 13 have been investigated on laboratory animals with the following results:

1. The single dose oral LD₅₀ of DOWICIL S 13 for guinea pigs is 475 mg/kg body weight, male rats 775 mg/kg, female rats 743 mg/kg, mixed sex population rats 715 mg/kg and mice 879 mg/kg.
2. When applied to the eye of rabbits, this material caused severe conjunctivitis and corneal injury if the eye remained unwashed. Washing of the eye within 30 seconds following application reduced the severity of the injury.
3. The material when dry produced no irritation or irritation produced and resolved upon application to the intact and abraded skin of the guinea pig. When

moistened with water, only a light transient redness occurred.

4. To evaluate the toxicity from absorption through the skin, the undiluted material was applied under an impervious cuff in the presence of excess moisture (water) for a contact period of 24 hours. Two animals treated in this manner survived a dose of 4.0 g/kg of body weight. Six animals, three with intact and three with abraded skin, were treated in a similar manner at a dose level of 2.0 g/kg body weight of material administered as a 25% solution of DOWANOL DPM (dipropylene glycol methyl ether). All six of these animals died within 24 hours. Animals treated similarly with a dose of 0.5 g/kg body weight administered as a 10% suspension in water, survived with no noticeable after effects.

Skin sensitization studies on DOWICIL S 13 alone have been conducted on guinea pigs. The results indicate that a high percentage of the animals became sensitized. Therefore, sensitization in humans may occur. Human experience in the handling of this product, especially in hot weather, has shown that it is capable of causing dermatitis in a limited number of people.

5. The skin sensitization potential of DOWICIL S 13 in latex paint was tested on human volunteers of mixed racial background. The test material was a typical acrylic latex paint with DOWICIL S 13 added at 10 pounds per 100 gallons of paint. Three 30-minute exposures per day were made on Monday, Tuesday, and Friday for three weeks for a total of 27 exposures. A final challenge application was made after a 4-week period. No positive reactions of the

test, no irritation or sensitization responses were observed. Therefore, small amounts of DOWICIL S 13 recommended for the preservation of most paint products is expected to have little or no significant effect on the toxicological properties of the final product. However, the appropriateness and safety of each proposed use of DOWICIL S 13 should be evaluated on the basis of suitable toxicological tests of the final product itself.

First Aid Measures

Eye Contact At the first evidence of contact with DOWICIL S 13, the eyes should be flushed immediately with copious amounts of flowing water for at least 15 minutes. Medical attention should be obtained promptly.

Skin Contact If obvious contamination occurs, the contaminated clothing including shoes, should be removed immediately and the affected skin areas should be washed thoroughly with soap and plenty of water. Contaminated clothing and shoes should not be reused until thoroughly cleaned. Medical attention should be obtained if any skin effects develop.

Inhalation If a person experiences an adverse effect from breathing dust or mists of this material, remove them to fresh air and keep them quiet and warm. Medical attention should be obtained if necessary.

Ingestion If DOWICIL S 13 Antimicrobial has been swallowed, medical attention should be obtained without delay. The material should be vomited up, as possible, by tickling the back of the throat or by inducing an emesis with a 1% solution of bicarbonate of soda. If the patient is unconscious, do not

8 Handling Precautions

The use of DOWICIL S 13 must be designed in such a way that contamination of air and surfaces is avoided, thus minimizing the possibility of overexposure. As much as possible, the handling and use of DOWICIL S 13 must be done in a closed system, including provisions for cleaning process effluents. The following precautions are intended for use in those areas and/or operations where complete control of the material is not possible.

Always protect the eyes from contact with either the solid itself or solutions or suspensions of the material. A minimum of safety glasses with side shields should be worn whenever working with DOWICIL S 13 even when probability of direct contact is minimal. Tight-fitting chemical works goggles, or equivalent, should be worn whenever the operation is obviously dusty or where the possibility of gross contact is high. Each worker should know the location and operation of safety showers, eye baths, and drinking fountains for use in flushing contaminated eyes.

The value of good personal hygiene practices in preventing skin irritation cannot be overstated. The skin and clothing should always be kept clean. The avoidance of skin contact is imperative, not only because of the irritation potential but also, and more importantly, because DOWICIL S 13 Antimicrobial has been shown to be a sensitizer of human skin (it is capable of producing an allergic type response).

It is important to prevent the dispersal of dust or mists containing DOWICIL S 13 into work areas. Careful design of equipment and procedures is necessary in accomplishing this. Local exhaust ventilation may be required at specific operations. Where the likelihood of exposure to dust or mists containing DOWICIL S 13 cannot be eliminated by mechanical means, workers should wear appropriate

personal protective equipment. It should be emphasized that personal protective equipment is a secondary means of protection and is not an adequate substitute for good safe working conditions, adequate ventilation and intelligent conduct on the part of employees. Because of the irritation potential of DOWICIL S 13, paint containing this product should not be sprayed. If spray application is a necessity, contact The Dow Chemical Company, Designed Products Department for recommendations.

Combustibility Characteristics

DOWICIL S 13 Antimicrobial, like most organic materials, will burn under the right conditions of heat and oxygen supply. Fires can be extinguished by conventional means, with water fog or CO₂ recommended. Decomposition products may include hydrogen chloride so fire fighters should wear self-contained breathing apparatus.

Spills and Disposal

This product is toxic to fish. Therefore treated effluent, spills, wastes, and water used to clean equipment must not be permitted to drain into lakes, streams, ponds or public water.

Spills or other waste of DOWICIL S 13 Antimicrobial should be swept up using floor sweeping compound. The spill area then should be flushed with water to ground.

Disposal of wastes and containers can be in an approved landfill subject to no drainage into potable or public water resource. Emptied containers should not be reused. Disposal of wastes and containers also can be by burning in an approved incinerator. Incinerator operators and other personnel must keep away from smoke or fumes. In any disposal of wastes, be certain that applicable Federal, state, and local regulations are met.

Dow encourages its customers to review their applications of Dow products from the standpoint of human health and environmental quality. To help ensure that Dow products are not used in ways for which they are not intended or tested, Dow personnel are willing to assist customers in dealing with ecological and product safety considerations. Your Dow salesman can arrange the proper contacts.