KATHON™ FP 1.5 Fuel Biocide

CAS Registry No. 26172-55-4 (CMIT), 2682-20-4 (MIT)
Mixture 3:1: (CMIT/MIT) as registry No.: 55965-84-9
EINECS No. EC 2475007 (CMIT), EC 2202396 (MIT)

General

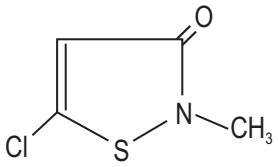
KATHON™ FP 1.5 contains a 3:1 ratio mixture of 5-chloro-2-methyl-3(2H)isothiazolone and 2-methyl-3(2H)isothiazolone (CAS N°55965-84-9), (abbreviated name CMIT/MIT). KATHON FP 1.5 is a solution of the technical grade of the active ingredient, CMIT/MIT, in dipropylene glycol at a nominal value of 1.5% of active substance. This biocidal substance has been notified under the Biocidal Products Directive (BPD; notification # 408) and is registered with the United States Environmental Protection Agency (US EPA).

KATHON FP 1.5 is effective at low use levels, against microbial species commonly encountered in fuel systems, including bacteria, yeast, and mold. KATHON FP 1.5 is designed to cause inhibition of microbial growth upon contact, and quickly result in cell death. The exact time to kill all microbes in a fuel will vary, but will typically be between 6 and 36 hours.

KATHON FP 1.5 is effective in systems containing both fuel and water. Unlike other fuel treatment biocides, the active ingredients in KATHON FP 1.5 are *not* deactivated by water.

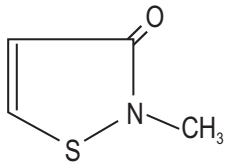
Structure

5-chloro-2-methyl-3(2H)isothiazolone



C_4H_4ClNOS (CMIT)

2-methyl-3(2H)isothiazolone



C_4H_5NOS (MIT)

Physical Properties

The following are typical properties of KATHON™ FP 1.5; **they are not to be considered product specifications.**

Molecular weight (g/mol): ..... 149.45 (CMIT), 115.16 (MIT), Average MW for 3:1 Mixture - 140.14.
Appearance/odor: ..... Yellow liquid with a mild odor
pH: 4-6
Specific gravity: 1.04
Viscosity (@25°C): ..... 97.8 CpS
Solvent: ..... Dipropylene Glycol
Volatility: ..... Non-volatile (no contribution to VOC)
Freezing point: ..... < -20°C (-4°F)
Storage conditions: ..... Min. ≥ -15°C (≥ 5°F), Max. ≤ 55°C (≤ 131°F)

Applications/Uses

Aviation Fuels
Water and sludge should be removed from fuel tanks before application of the biocide.

100ppm v/v of KATHON™ FP 1.5 as supplied should be used to achieve microbial control, as described by EU BPD and US EPA regulations. To achieve this, the user should treat

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every 10,000 litres of aviation fuel with 1 litre of KATHON FP 1.5. The biocide should be added in such a manner so as to allow good mixing and distribution across the fuel. Ideally, this should be into a fuel supply line to ensure agitation. A contact time of up to 24 hours is recommended, depending on the severity of infection.

All Other Fuels

Water and sludge should be removed from fuel tanks before application of biocide and again after the retention period.

KATHON™ FP 1.5 has been tested and found effective in a wide range of fuels, including diesel, petrol, ULSD, biodiesel, kerosene, gasoline, and other fuels used in marine, aviation, automotive and home heating applications.

KATHON FP 1.5 is typically dosed at 200 to 300 ppm (200mL to 300mL per 1000L fuel) for curative treatment (i.e. when there is evidence of bacterial contamination). A minimum residence time of 12 hours should be allowed, before the fuel is used, though 24 hours is recommended. The biocide should be added in such a manner so as to allow good mixing uniform distribution of the biocide across the fuel.

KATHON FP 1.5 can also be used as a preventative/maintenance measure (to guard against bacterial contamination) in fuels that lack microbial contamination. For such a use, the recommended dosage is 100 to 150 ppm (100-150mL per 1000L fuel). The biocide should be added in such a manner so as to allow good mixing and uniform distribution of the biocide across the fuel. In such a case the residence time should still be at least 12 hours. *Extreme care must be taken to avoid the addition of a preventative/maintenance level dosage of KATHON FP 1.5 to a heavily contaminated fuel system.*

KATHON FP 1.5 can also be used as a shock biocide, for fuels that are heavily contaminated. If this is the case, doses up to 1000 ppm can be administered (1L biocide per 1000L fuel) according to the BPD. The US EPA allows the use of up to 400 ppm KATHON FP 1.5 in heavily contaminated fuel systems (400mL biocide per 1000L fuel). In this case, the residence time is recommended to be a full 24 hours.

Appropriate precautions should be taken for all of the dosing methods described above, which include the following:

- Avoid dermal contact – suitable PPE should be employed, including suitable gloves of butyl rubber or nitrile rubber, safety goggles, and if required, a face shield. Consult the Safety Data Sheet (SDS) for full details
- Fuel tanks being treated should be at least 10% full before treatment. Do not dispense into empty fuel tanks
- Use KATHON FP 1.5 in accordance with local regulatory requirements (ex: BPD or US EPA), and **do not exceed recommended dose levels**
- It is not recommended to dispense KATHON FP 1.5 directly into road vehicle fuel tanks. Road vehicle fuel tanks should be filled with fuel already treated with KATHON FP 1.5
- When treating storage tanks, please note that effective treatment will only be achieved with efficient mixing. Ideally, KATHON FP 1.5 should be dosed into a flowing fuel stream in the storage tank inlet
- Other methods, such as bulk dosing, will not affect the performance of KATHON FP 1.5, but might extend the treatment time required
- KATHON FP 1.5 is not surface active and therefore will not inhibit water separation

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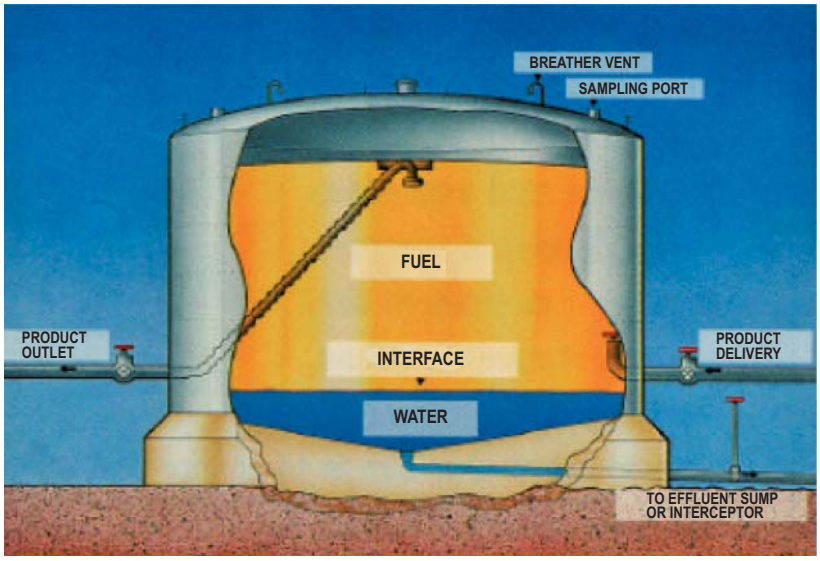
Efficacy of KATHON™ FP 1.5 in fuels

Microbial contamination is not specific to any one fuel type – diesel, petrol, ULSD, biodiesel, kerosene, gasoline, and other fuels used in marine, aviation, automotive and home heating applications are all susceptible. Similarly there is no single specific organism that can be identified as being responsible for degradation and spoilage. As a general rule, wherever fuel and water come into contact in a storage or distribution system microbial contamination is likely to occur.



No matter how well maintained a storage system is, a water bottom is almost invariably present. This results from a number of sources:

- Freshly refined fuel contains some water. This separates out as the fuel cools down
- Atmospheric condensation: humidity in the air in the storage tank condenses out and adds to the water bottom
- Rain or snow may enter the tank via sampling ports, breather vents or ill -fitting seals on floating roofs
- Transport or storage in tankers or barges can result in contamination from ballast Water

In addition certain end use applications – notably marine fuel – naturally lend themselves to allow water ingress into a storage system. Water from all of these sources accumulates in the storage tank to form the water bottom.

Microorganisms can be air or waterborne. Consequently as the water bottom develops a microbial population builds up in it. For many of the species present in the water bottom, liquid hydrocarbon fuels represent an excellent nutrient source. As a result there is a population explosion: the microorganisms proliferate at the fuel/water interface, surviving in the water phase whilst feeding on the fuel. In so doing, they secrete detrimental waste into the fuel and can push the fuel out of specification.

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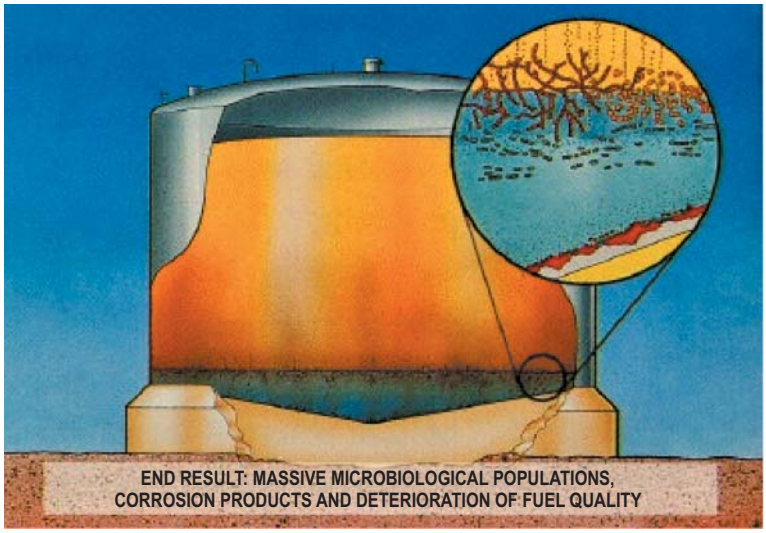

In the initial stages of contamination the organisms present are predominantly aerobic, using the dissolved oxygen in the water for respiration. As this supply of oxygen is depleted, anaerobic organisms, known as sulphate reducing bacteria, develop. These organisms do not require oxygen for respiration and form corrosive waste products such as hydrogen sulphide.

Consequences of Microbial Growth

Once a microbial population becomes established fuel quality rapidly deteriorates. As outlined below problems such as haziness, failure to meet specifications, corrosion, filter plugging and additive degradation can occur. All of these problems are related directly to the presence of microorganisms or their associated by-products.

Fuel Haziness: This is a clear indication that fuel is out of specification. The primary cause of haziness is an increase in the water content of the fuel resulting from the production of biosurfactants. These are by-products of microbial growth and alter the surface tension at the fuel/water interface. As a consequence the solubility of water in the fuel is increased.

Degradation of Additives: Certain additives, especially those rich in nitrogen and/or phosphorous, encourage microbial growth. In the process the additives are degraded and consequently their effect is lost.

Microbially Induced Corrosion: MIC is associated with biofilm growth on surfaces within fuel tanks and pipe lines. In particular, Sulphate Reducing Bacteria can produce H_2S. This is easily soluble, highly corrosive, and will contribute to increased localized corrosion (pitting).

Sludge Formation: Microbial debris is deposited on the tank bottom where it forms a layer of sludge. This sludge creates an environment which favours microbially induced corrosion. It may also become contaminated with viable microorganisms and unless removed will act as a reservoir of infection every time the tank is used.

Filter Plugging: Biopolymers are formed during microbial growth. These are viscous, adhesive substances which, along with microbial and other debris, are deposited on filters and pipes leading to reduced flow rates and blockages. At end user level this can have serious consequences causing engine damage and in extreme cases complete failure.

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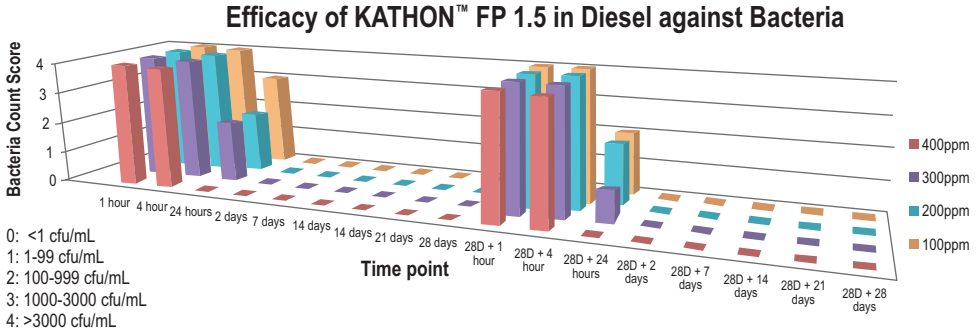
Odor: A problem commonly associated with microbially contaminated fuel is that of foul odor. This is principally as a result of hydrogen sulphide production by sulphate reducing bacteria.

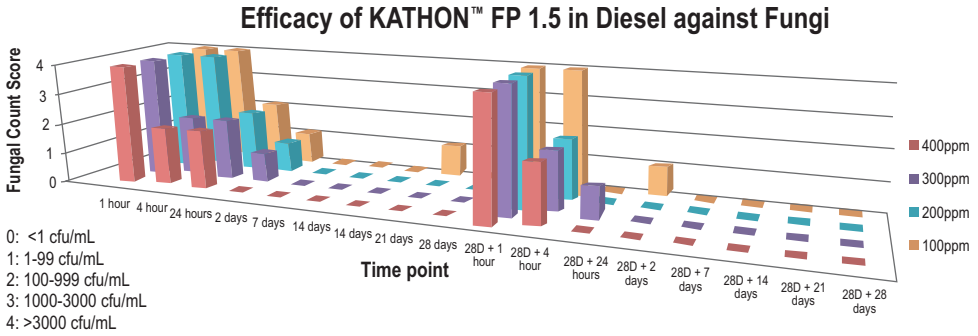
Features and Benefits

Broad Spectrum Activity: KATHON™ FP 1.5 is effective at very low use levels against microbial species (bacteria, fungi, yeasts) commonly encountered in fuel systems. Full details of minimum inhibitory concentration values of KATHON FP 1.5 against a range of microorganisms can be found on page 8 of this technical bulletin.

Rapid Inhibition of Microbial Growth: KATHON FP 1.5 causes immediate inhibition of growth on coming into contact with a microorganism. Growth inhibition rapidly becomes irreversible and results in cell death. The time to achieve eradication varies according to the extent of contamination and the type of microorganisms present. Typically, as the graphs below indicate, within 24 hours of treatment the fuel will again be fit for use.



Note: The test was reinoculated with bacteria at 28 days to measure long term protection capability



Note: The test was reinoculated with fungi at 28 days to measure long term protection capability

Long Term Preservation: Fuel treated with KATHON FP 1.5 will remain protected from contamination over extended periods of time. It will also resist contamination if reinoculated from another source. In studies conducted over an 8 week period, contaminated fuels were treated with fuel biocides. Once microbial control was established, the fuel was reinoculated with microbes, to measure long term protection capability. KATHON FP 1.5 was not dosed for a second time. The initial dose was still able to protect against bacteria and fungi.

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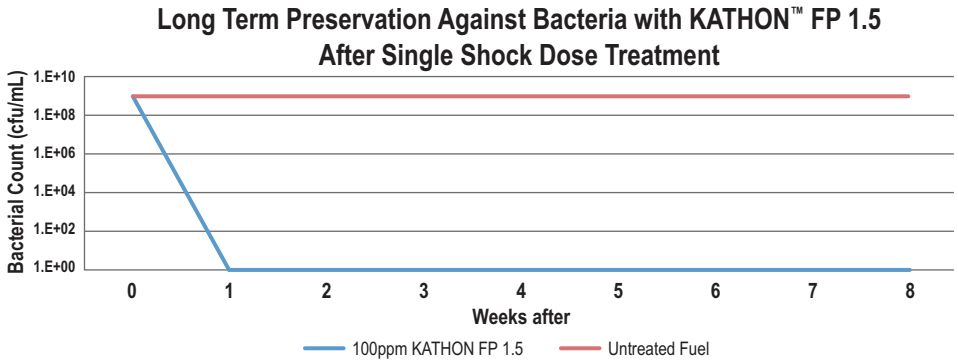
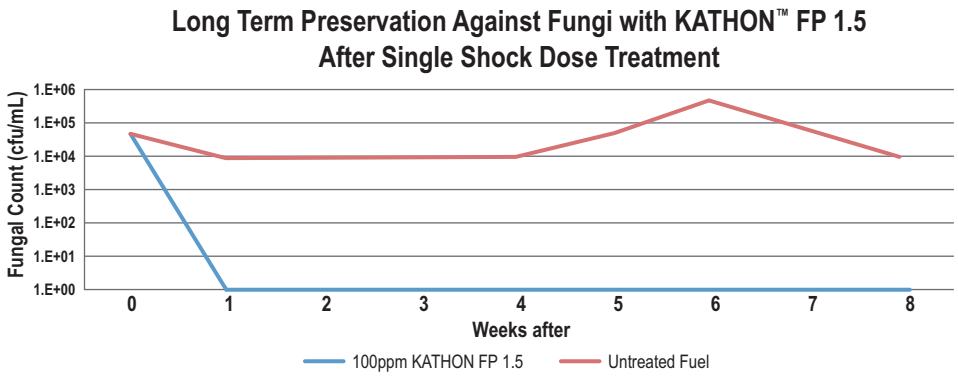
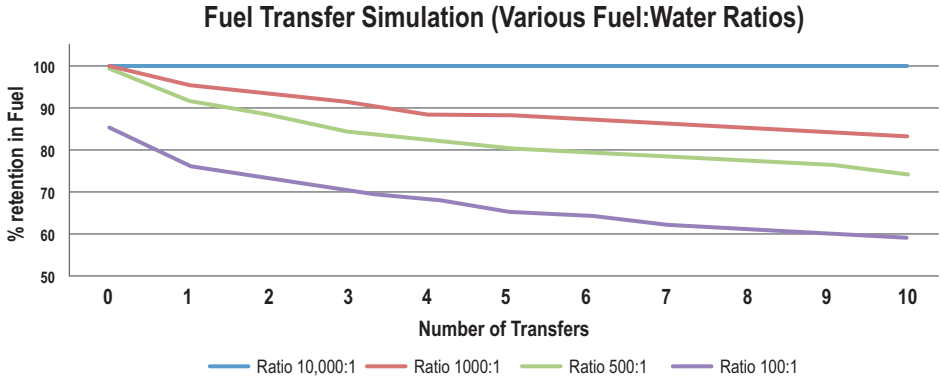




Complete System Protection: The partitioning characteristics of KATHON™ FP 1.5 ensure that it is present in both the fuel and water phases. This facilitates eradication of contamination in the water bottom as well as protection of the fuel as it is transferred through the distribution system.

The extent to which KATHON FP 1.5 partitions between the fuel and water phases varies according to the fuel/water ratio. Results from computer modelling indicate that after a series of 10 transfers, between 60% (fuel/water ratio of 100:1) and 97% (fuel/water ratio of 10,000:1) of the KATHON FP 1.5 originally dosed is retained in the fuel and is then available to subsequently repartition to the water bottom to maintain efficacy.

Data generated in the field support this model. Fuel was treated at refinery storage level. It was then transferred through the usual distribution system. Analysis of the fuel was carried out at 3 points in the system. At end user level almost 88% of the original active ingredient dosed was present.



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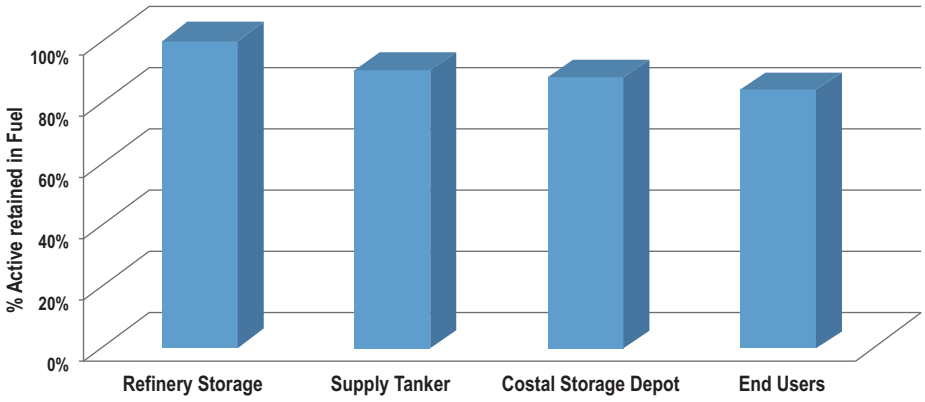
The above graph shows what happens when fuel is transferred between facilities. Even when high water content of the fuel is maintained (to simulate poor water control) , the partitioning capability of KATHON™ FP 1.5 ensures that even after 10 transfers, at least 60% of the KATHON FP 1.5 is still present in the fuel, and therefore able to inhibit microbial growth.

Multiple Transfers: % Active remaining in Fuel



Fuel:Water Ratios:
Refinery Storage 10,000:1
Supply Tanker 1,000:1
Coastal Storage Depot 1,000:1
End Users 500:1

This shows that fuel treated with KATHON FP 1.5 remains protected as it is transferred through the distribution chain.

Widely Approved: KATHON FP 1.5 Fuel Biocide has wide ranging approvals in aviation, marine, automotive, home heating and military fuels. Approvals have been obtained from:

- Specialist fuel companies
- Customs accredited laboratories
- Global militaries
- Industrial gas turbine manufacturers
- Diesel engine manufacturers
- Commercial airlines
- Filtration equipment manufacturers
- Airframe manufacturers
- Aviation engine manufacturers
- Aviation auxiliary power unit manufacturers

Note: Please consult your Dow representative to confirm approval for your specific application.

Safety and Support: Dow Microbial Control offers customers a comprehensive package of support services and data to promote the safe and effective use of KATHON™ FP 1.5. This includes extensive data on environmental fate, toxicology and materials compatibility and advice and assistance in areas such as disposal, product handling and delivery/dosing systems.

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Inhibition of Contaminants

The minimum concentration of KATHON™ FP 1.5 required to inhibit commonly occurring fuel contaminants are given below.

Organism Type	Organism	ATCC #	MIC (ppm AI)
Mold[a]	*Hormoconis resinae*[c]	22712	3
Yeast[b]	*Candida albicans*	16651	1.5
	Candida lipolytica[c]	16617	1.5
Bacteria[b]	*Citrobacter freundii*	6750	1.5
	Enterobacter aerogenes	13048	0.375
	Escherichia coli	11229	1.5
	Proteus mirabilis	4675	1.5
	Pseudomonas aeruginosa[c]	33988	0.375
	Pseudomonas oleoverans	8062	0.375

[a] – MIC at 7 days
[b] – MIC at 48 Hours
[c] – Hydrocarbon utilising microorganism

The data in the table above was achieved under laboratory testing, and under controlled conditions. These data are intended as an indication of the broad spectrum of activity of KATHON FP 1.5, and should not be interpreted as having relevance to the effectiveness or dosing against specific bacteria in formulated products or in process systems. The data cannot be used to predict performance in fuels. Dow Microbial Control always recommends that a microbial study of the fuel is carried out before a treatment strategy is decided.

Disposal of KATHON™ FP 1.5

KATHON™ FP 1.5 will partition into both the fuel and water phase in a fuel system. Although the vast majority of the biocide dosed remains dissolved in the fuel, the actual concentration of biocide in the water is several fold higher due to the partition coefficient of the actives. The exact concentrations in each phase will depend on several factors, including the fuel/water ratio, the initial dose of biocide, length of storage time, rate of fuel replenishment, and environmental conditions within the tank.

As with most biocides, KATHON FP 1.5 can be toxic to aquatic organisms. Water bottoms and effluents must therefore be diluted prior to discharge and discharged in accordance with local environmental and legal regulations.

KATHON FP 1.5 is biodegradable and is non-persistent in the environment. Dilution to below effective levels will facilitate its degradation - the greater the dilution factor the more rapid is the degradation. For guidance on approved discharge procedures, please contact Dow Microbial Control or consult local authorities.

Neutralisation methods will vary depending on the situation the biocide is in. In cases of accidental spill or excess biocide in equipment (or other situations when the product is not being applied), the biocide can be neutralised by the addition of a 5% solution of Sodium Bicarbonate ($NaHCO_3$) and 5% Sodium Hypochlorite (NaOCl) in water. Apply solution to the spill area or product at a ratio of 10 volumes deactivating solution per estimated volume of biocide. After 30 minutes, flush the spill area or equipment with excess amounts of water, to a chemical sewer (if in accordance with local procedures, permits, and regulations). DO NOT add deactivation solution to a waste pail to deactivate adsorbed material.

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If the product is to be neutralised *after* application (for example, in tank water bottoms before disposal), a slightly acidic 10% solution of Sodium Metabisulphite (NaS_2O_5) or Sodium Bisulphite ($NaHSO_3$) can be used, in the ratio of 4:1 (Deactivating solution: KATHON™ FP 1.5).

Chemical deactivation of large amounts of KATHON FP 1.5 must not take place in bulk storage tanks. The effluents must be isolated safely before deactivation.

Further information regarding spill procedures can be found in the (SDS).

When used at refinery level, another convenient method of deactivation can be used. Waters containing KATHON FP 1.5 can be passed into waste waters from the hydrodesulphurisation process. The hydrogen sulphide present will rapidly deactivate KATHON FP 1.5.

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner. It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow technical representative for more information.

Compatibility data for KATHON™ FP 1.5

Metals	Plastics	Elastomers	FRP/Coatings
316L SS	HDPE	Viton	Vinyl Ester (Plasite 4300)
Titanium	FI-HDPE		Baked Epoxy (Plasite 9570)
Hastelloy C276	Ryton		Polyester Fumarate Resin (Atlac 382)
	Polypropylene		
	Teflon		

KATHON™ FP 1.5 is not compatible with the following:

Metals	Plastics	Elastomers
Carbon Steel	PVC	EDPM-Nordel
316 SS		Butyl Rubber
316 Ti-SS*		Buna N
304L SS		Buna S
304 SS		Neoprene

*Titanium stabilised 316 SS can have variable metallurgy and some versions *are* compatible with Kathon formulations.

Safety Hazards and Handling

Before using this product, consult the Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

Technical Assistance

Dow Microbial Control Laboratories are available to provide specialised technical support to all of our customers.

Services available include:

- Identification of sources of contamination.
- Design of treatment programs to meet specific needs.
- Monitoring of KATHON™ FP 1.5 levels in fuel samples.
- Advice and assistance on procedures to avoid the recurrence of microbial growth.

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Specific or particularly heavy service requirements should be discussed with Dow Microbial Control in advance. In the event that high levels of routine testing or a permanent presence on site are required, Dow Microbial Control will be pleased to recommend a company specialised in the provision of these services.

Product Stewardship

When considering the use of any Dow 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. Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products – from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

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

For further information visit our website:
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