UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D. C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Revised Reregistration Environmental Risk Assessment for Metam Sodium and Metam Potassium (PC Code 039003 and 039002; DP Code D293340)

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This memo summarizes the Environmental Fate and Effects Division (EFED) screening-level Environmental Risk Assessment of metam sodium reregistration. Metam sodium is a widely used fumigant on agricultural and non-agricultural sites as a preplant soil sterilant to control nematodes, soil-borne diseases, insects and weeds**.** Metam potassium is the potassium salt analog of metam sodium. Since, these chemicals have virtually identical physical-chemical properties and a similar use profile, the ecological risk assessment of metam sodium should be applicable to metam potassium. Metam sodium is highly unstable in the environment, degrading rapidly to form the active ingredient methyl isothiocyanate (MITC). Repeated application of metam sodium at the same site may cause microbial induced fast degradation of MITC resulting in the compromise of biocidal activities of metam sodium. The high vapor pressure and low affinity for sorption on soil of MITC suggest that volatilization is the most important environmental route of dissipation and to a lesser extent leaching and degradation.

The major concern with metam sodium is the exposure of terrestrial and aquatic organisms to the degradate MITC. Acute Levels of Concern (LOC) are substantially exceeded for mammals, based on an LD50/square foot risk assessment screen. An analysis using mammal inhalation data and theoretical maximum ground-level air residues of MITC also indicates an acute risk concern, as well as a potential for exposure over a prolonged period. This analysis also suggests a potential for risk to birds via the inhalation route (avian inhalation toxicity data are needed for a complete assessment). Birds and mammals could have territories or home ranges in the area and be exposed substantially and/or repeatedly, due to the use of metam-sodium on multiple fields over multiple days in any given geographic area. Acute aquatic LOCs are exceeded for both aquatic invertebrates and fish in all modeled scenarios except potatoes.

Metam sodium reacts on contact with moist soil and degrades rapidly to generate methyl isothiocyanate (MITC), a volatile biocidal active product. Once MITC volatilizes into the atmosphere, it dissipates rapidly due to direct photolysis. In a laboratory experiment, several MITC minor degradates were identified that include methyl isocyanate (MIC), methyl isocyanide, sulfur dioxide, hydrogen sulfide, carbonyl sulfur, N-methylthioformamide, and methylamine resulting from direct photolysis. Air monitoring studies suggest that the metam sodium application methods affected the volatility rates of MITC and consequently dictated the ambient residue of MITC and its metabolites in the air samples. Air monitoring in California shows the highest MITC concentration occurred during metam sodium application through a sprinkler irrigation system followed by water-sealing. Levels ranged from 78.3 to 2450 ppb at 5 meters from the field edge and 11.7 to 1320 ppb at 150 meters from the field edge. Hydrogen sulfide and MIC were also detected in air samples during the application and post application periods. MIC is known to be very reactive and toxic to animals. However, MIC concentrations in the California air monitoring study were low (0.9 to 2.5 ppb).

Based on the labeled phytotoxicity of MITC (and the limited reporting of some off-site incidents), non-target plants off-site will likely also be at some risk from off-gassed MITC. Terrestrial plant toxicity data are needed to evaluate this risk. LOCs for aquatic plants are not exceeded based on available data, but additional toxicity data are needed to complete this assessment.

Based on PRZM/EXAMS modeling of MITC (at 320 lb ai/A of metam-sodium), acute aquatic LOCs are exceeded for both aquatic invertebrates and fish in all scenarios except potatoes. Chronic aquatic LOCs are not exceeded for aquatic invertebrates at any modeled site. Chronic fish data on MITC are needed to evaluate chronic risk to fish from MITC. However, chronic exposure to MITC is expected to be low because of its high potential to volatilize from the surface water bodies. Also, the low octanol/water partition coefficient of MITC indicates that it is not likely to be bioconcentrated in tissues of aquatic organisms.

Although MITC is volatile, it is also very soluble in water and its low adsorption in soil suggest that leaching to ground water may be a potential problem under flooded condition. However, under most field conditions, the potential for ground water contamination of MITC is unlikely due to its volatilization and fast degradation characteristics in soil. Based on non-targeted monitoring data, no MITC was detected in the

ground water samples within the USA. MITC can also potentially move to surface water through runoff under a possible worst-case scenario, that is, if an intense rainfall and/or continuous irrigation occurs right after metam sodium application. However, the Henry's Law Constant of MITC suggests that it will be volatilized from surface water. No monitoring data of MITC in surface water is available at the present time.

The Estimated Drinking Water Concentrations (EDWCs) for metam sodium and its metabolite MITC were calculated based on a maximum application rate of 320 lbs. a.i./Acre. The models, PRZM/EXAMS and SCIGROW were used in estimating EDWCs in surface water and groundwater, respectively. The acute concentrations in surface water are 0.03：g/L for metam sodium and 73.22 ：g/L for MITC. The cancer chronic concentrations are 2.99 ：g/L for MITC and negligible (#0.001 ：g/L) for metam sodium using the Florida tomato scenario. These values represent the mean value over a 30-year period. Several other scenarios (onion, strawberry, and turf) were also investigated but gave consistently lower EDWCs. The SCIGROW generated EDWCs for tomato is 0.13：g/L for metam sodium and 0.72 ：g/L for MITC, which are recommended to use for both acute and chronic exposures.

Outstanding Data Requirements

Environmental Fate: Metam Sodium

The environmental fate data base for the parent compound is largely complete (Table A1-B). The following environmental fate studies were not submitted and no further actions will be needed.

162-3 Anaerobic aquatic metabolism of metam sodium. Metam sodium is very unstable and degrades rapidly in soil and water to generate MITC, which volatilizes into the atmosphere. Anaerobic soil metabolism study will not provide additional information.

165-4 Bioaccumulation in fish of metam sodium The octanol/water partition coefficient ($\log K_{ow}$) for metam sodium is less than 0.46, indicating a low potential for metam sodium to bioaccumulate in aquatic organisms. Therefore, bioaccumulation in fish study is not required under the above circumstances according to the Subdivision N guidelines.

Environmental Fate: MITC

The laboratory studies successfully characterize the degradation of metam sodium, however, a key environmental fate study of "Photodegradation of MITC in Air" was not provided by the registrant (Table A1-C). In addition, supplemental studies of aerobic soil metabolism and adsorption/desorption have several deficiencies and problems. Therefore, these key environmental fate data as well as other fate data were obtained from open literature to complete the environmental fate and exposure assessment of MITC.

161-4 Photodegradation in Air This study was not provided by the registrant. However, a study done by Geddes et al. (1995) provided pertinent information required by this study. Therefore, a new study will not be required at this time.

(Geddes, J.D., G.C. Miller, and G. E. Taylor Jr. 1995. Gas phase photolysis of methyl isothiocyanate. Environ. Sci. Technol. 29:2590-2594.)

162-1 Aerobic Soil Metabolism This aerobic soil metabolism study of MITC has been deemed supplemental, but the bodies of evidence suggest that there is no need of additional studies under the present guideline. A study done by Gerstl et al. (1977) provided pertinent information.

(Gerstl, Z., U. Mingelgrin, B. Yaron. 1977. Behavior of Vapam and Methylisothiocyanate in soils. Soil Sci. Soc. Am. J. 41: 545-548)

163-1 Adsorption/Desorption of MITC The experiments were conducted with foreign soils from Japan. Most of the Japanese soils derived from volcanic parent materials that are considerably different from the majority mineral soils of continental USA. A study done by Gerstl et al. (1977) provided pertinent information required by this study.

(Gerstl, Z., U. Mingelgrin, B. Yaron. 1977. Behavior of Vapam and Methylisothiocyanate in soils. Soil Sci. Soc. Am. J. 41: 545-548)

163-3 Field Volatility Field volatility of metam sodium essentially captured the volatility of MITC as well. No additional study is required.

164-1 Terrestrial Field Dissipation Terrestrial field dissipation of metam sodium study essentially captured the dissipation of MITC as well. Therefore, no additional study is required.

165-4 Bioaccumulation in fish of MITC The octanol/water partition coefficient ($\log K_{ow}$) for MITC is less than 0.98, indicating a low potential for MITC to bioaccumulate in aquatic organisms. Therefore, bioaccumulation in fish study is not required under the above circumstances according to the Subdivision N guidelines.

Ecological Effects:

71-1 Avian Acute Oral, MITC. The current estimate of avian risk is based largely on the mammal assessment. This basic study will contribute to a risk assessment specific to birds.

----- Avian acute inhalation, MITC. The current estimate of avian risk is based largely on the mammal assessment. This study will enable an inhalation risk assessment specific to birds.

-----Avian sub-chronic/chronic inhalation, MITC. This study is needed for risk assessment, due to the potential for repeat and/or continuous exposure to birds resulting from the use of metam-sodium on multiple fields over multiple days in any given geographic area.

72-3 (a) Acute Marine/Estuarine Fish, MITC. The aquatic risk assessment of metam-sodium use is based on exposure to MITC. Given the use patterns of metam-sodium, marine/estuarine species could also be exposed. This study will enable a risk assessment for marine/estuarine species exposure.

72-3(b) Acute Marine/Estuarine Mollusk, MITC. The aquatic risk assessment of metam-sodium use is based on exposure to MITC. Given the use patterns of metam-sodium, marine/estuarine species could also be exposed. This study will enable a risk assessment for marine/estuarine species exposure. It will also improve certainty with the endangered species risk assessment, as this test species may be more representative of endangered freshwater mussels than the freshwater *Daphnia*.

72-3 (c) Acute Marine/Estuarine Shrimp, MITC. The aquatic risk assessment of metam-sodium use is based on exposure to MITC. Given the use patterns of metam-sodium, marine/estuarine species could also be exposed. This study will enable a risk assessment for marine/estuarine species exposure.

72-4(a) Early Life-stage Fish – Freshwater, MITC. Current aquatic modeling indicates the potential for chronic aquatic exposure to MITC. This study will enable a chronic risk assessment for freshwater fish.

72-4(a) Early Life-stage Fish – Marine/Estuarine, MITC. Current aquatic modeling indicates the potential for chronic aquatic exposure to MITC. This study is reserved pending the submission and review of the above early life-stage study with a freshwater fish species.

72-4(b) Life-Cycle Aquatic Invertebrate, MITC. The current chronic risk assessment for aquatic invertebrates is based on a Supplemental study (MRID #4563400). Submission of a Core study will reduce uncertainty.

72-5 Life-Cycle Fish, MITC. This study is reserved, pending submission and review of early life-stage fish testing.

123-1(a) Seed Germination/Seedling Emergence – Tier II, MITC. Metam-sodium is used in part due to the phytotoxicity of MITC at the application site. This study will enable the assessment of risk to non-target terrestrial plants off-site.

123-1(b) Vegetative Vigor – Tier II, MITC. Metam-sodium is used in part due to the phytotoxicity of MITC at the application site. This study will enable the assessment of risk to non-target terrestrial plants off-site.

123-2 Aquatic Plant Growth – Tier II, MITC. Only one of four tests currently available (on duckweed) is considered to be Core (MRID #45919422). The submission of remaining test species under this guideline will reduce uncertainty and improve the assessment of risk to aquatic plants.

Uncertainties

Environmental Fate and Exposure

The laboratory studies successfully characterize the degradation of metam sodium, however, several key environmental fate studies of the major metabolite MITC were not provided. The essential fate data were obtained from open literature to complete the environmental fate and exposure assessment for MITC. However, these studies provided very limited information related to the formation and decline of metabolites of MITC in soil and water. The Agency is not requiring additional fate data for MITC at this time. However, the true extent of this compound's ultimate fate can only be gauged through a review of additional environmental fate of MITC in soil and water studies capable of capturing the above concerns.

Ecological Effects:

The uncertainties associated with the risk to terrestrial organisms from metam-sodium use are mainly focused on the extent and effect of terrestrial animal exposure via inhalation to MITC. Avian inhalation toxicity data are not available, as indicated above. Terrestrial plant data are needed to conduct an assessment of risk to non-target terrestrial plants off-site.

Because of the repeat exposures from applications to different fields on different days in a given geographic area, there is the added potential for chronic exposure. HED has indicated in their preliminary risk assessment (4/13/04) that a chronic mammal inhalation study (two generation reproduction study) with MITC is needed. A chronic avian inhalation study will enable EFED to address chronic exposure to birds as well.

The uncertainties associated with the risk to aquatic organisms from metam-sodium use are mainly focused on the effects of aquatic exposure to MITC that may be very brief due to high volatility. However, chronic exposure is possible, in part due to repeat or continuous input to the aquatic environment. Acute toxicity data on MITC are not available for marine/estuarine organisms. Chronic toxicity data are not available for freshwater fish. The risk assessment relies on Supplemental data for aquatic invertebrate chronic toxicity and non-vascular aquatic plant growth.

EFED Label Recommendations

i. Manufacturing Use Product:

This pesticide is toxic to mammals, fish, and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA.

***ii. End-Use Product*:**

This pesticide is toxic to mammals, fish, and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in water adjacent to treated areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

Table A1(A). Ecological Effects Data Requirements for: Metam-sodium (including MITC, as indicated)

Guideline #	Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
71-1(a)	Avian Acute Oral	Y	41476402	C
71-1(a)	Avian Acute Oral (MITC)	N	----------	N/A
------	Avian Acute Inhalation (MITC)	N	----------	N/A
71-2(a)	Avian Dietary–quail	Y	4.1476e+23	S C C
71-2(b)	Avian Dietary–mallard	Y	4.1476e+23	S C C
---------	Avian Subchronic/Chronic Inhalation (MITC)	N	----------	N/A
72-1(a)	Fish Acute Toxicity–bluegill	Y	42363201*	C
72-1(a)	Fish Acute Toxicity–bluegill (MITC)	Y	44523412 = 42058002	C
72-1(b)	Fish Acute Toxicity–rainbow trout	Y	42363202*	C
72-1(b)	Fish Acute Toxicity–rainbow trout (MITC)	Y	44523413 =42058002 45919420	C S
72-2(a)	Aquatic Invertebrate Acute Toxicity–freshwater	Y	42680601* 40098001 41106203	C S S
72-2(a)	Aquatic Invertebrate Acute Toxicity–freshwater (MITC)	Y	4.1819e+15	C S
72-3(a)	Marine/Estuarine Acute Toxicity–Fish	Y	42436301*	C
72-3(a)	Marine/Estuarine Acute Toxicity–Fish (MITC)	N	----------	N/A
72-3(b)	Marine/Estuarine Acute Toxicity–Mollusk (shell deposition)	Y	42632201*	C
72-3(b)	Marine/Estuarine Acute Toxicity–Mollusk (shell deposition) (MITC)	N	----------	N/A

Table A1(A). Ecological Effects Data Requirements for: Metam-sodium (including MITC, as indicated)

Guideline #	Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
72-3(c)	Marine/Estuarine Acute Toxicity–Shrimp	Y	42476301*	C
72-3(c)	Marine/Estuarine Acute Toxicity–Shrimp (MITC)	N	----------	N/A
72-4(a)	Fish Early Life Stage–freshwater	N	----------	N/A
72-4(a)	Fish Early Life Stage–marine/estuarine	N (study reserved)	----------	N/A
72-4(b)	Aquatic Invertebrate Life Cycle–freshwater (MITC)	N	45634001	S
123-1(a)	Seedling Germination/Seedling Emergence–Tier II (MITC)	N	----------	N/A
123-1(b)	Vegetative Vigor–Tier II (MITC)	N	----------	N/A
123-2	Aquatic Plant Growth – Tier II (MITC)	Partially	4.5919e+31	C S S S
141-1	Honeybee Acute Contact	Y	5050045	C

C=Core; S=Supplemental; U=Unnaceptable; W=Waived; N/A=Not Applicable; NA=Not Available; Inv.=Invalid; R=Potentially Repairable

* Study on metam-potassium

Table A1 (B). Environmental Fate Data Requirements for: Metam Sodium

Guideline #	Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
161-1	Hydrolysis	Yes	416311-01	C
161-2	Photodegradation in Water	Yes	415177-01	C
161-3	Photodegradation on Soil	Partially	429787-01	S
161-4	Photodegradation in Air	NA	----------	W
162-1	Aerobic Soil Metabolism	Yes	401985-02	C
162-2	Anaerobic Soil Metabolism	No	-----------	N/A

Table A1 (B). Environmental Fate Data Requirements for: Metam Sodium

Guideline #	Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
162-3	Anaerobic Aquatic Metabolism	No	---------- -	N/A
162-4	Aerobic Aquatic Metabolism*	Partially	427102-01	S
163-1	Adsorption/Desorption	Partially	421769-01	S
163-2	Laboratory Volatility	N	----------	W
163-3	Field Volatility	Yes	426599-01	S
164-1	Terrestrial Field Dissipation	Partially	426566-01 426566-02	S
165-4	Accumulation in Fish/ Bioconcentration	N	----------	N/A

C=Core; S=Supplemental; U=Unnaceptable; W=Waived; N/A=Not Applicable; NA=Not Available
* Study on metam-potassium

Table A1 (C). Environmental Fate Data Requirements for MITC, a Major Transformation Product of Metam Sodium

Guideline #	Data Requirement	Is Data Requirement Satisfied?	MRID #'s	Study Classification
161-1	Hydrolysis	Yes	158162	C
161-2	Photodegradation in Water	No	----------	----------
161-3	Photodegradation on Soil	No	----------	----------
161-4	Photodegradation in Air	No	----------	----------
162-1	Aerobic Soil Metabolism	Partially	412214-16	S
162-2	Anaerobic Soil Metabolism	No	----------	----------
162-3	Anaerobic Aquatic Metabolism**	Partially	435965-01	S
162-4	Aerobic Aquatic Metabolism	Yes	----------	N/A
163-1	Adsorption/Desorption	Partially	459194-15	S
163-2	Laboratory Volatility	No	----------	----------
163-3	Field Volatility	No	----------	----------

164-1	Terrestrial Field Dissipation	No	----------	----------
165-4	Accumulation in Fish/ Bioconcentration	No	----------	----------

C=Core; S=Supplemental; U=Unnaceptable; W=Waived; N/A=Not Applicable; NA=Not Available

**** MITC (metabolite of Dazomet)**