要　旨

試験委託者

環境庁

表　題

2,2,6,6-テトラメチル-4-ピペリジノールの藻類（*Selenastrum capricornutum*）に対する生長阻害試験

試験番号

NMMP／E09／1070

試験方法

本試験は、OECD化学品テストガイドラインNo.201「藻類生長阻害試験」（1984年）に準拠して実施した。

1）被験物質　：2,2,6,6-テトラメチル-4-ピペリジノール
2）培養方式　：振とう培養（100rpm）
3）供試生物種　：*Selenastrum capricornutum*（ATCC-22662）
4）温度　：23±2 ℃
5）暴露期間　：72時間
6）試験液量　：100mL（ＯＥＣＤ培地）
7）照明　：4000～5000 lux（連続照明）
8）初期細胞濃度　：1×10^4 cells/mL
9）試験濃度（設定）：対照区、42mg/L、76mg/L、137mg/L、247mg/L、444mg/Lおよび800mg/L
10）試験液中被験物質の分析
：ＧＣ法（暴露開始時、終了時）

結　果

1）生長曲線下の面積の比較による生長阻害濃度

EbC50 (0-72)＝ 107mg/L (95%信頼区間：99mg/L～115mg/L)

無影響濃度 (NOEC(面積法 0-72)) ＝ 76mg/L

2）生長速度の比較による生長阻害濃度

ErC50 (24-48) ＝ 127mg/L (95%信頼区間：105mg/L～147mg/L)

無影響濃度 (NOEC(速度法 24-48)) ＝ 76mg/L

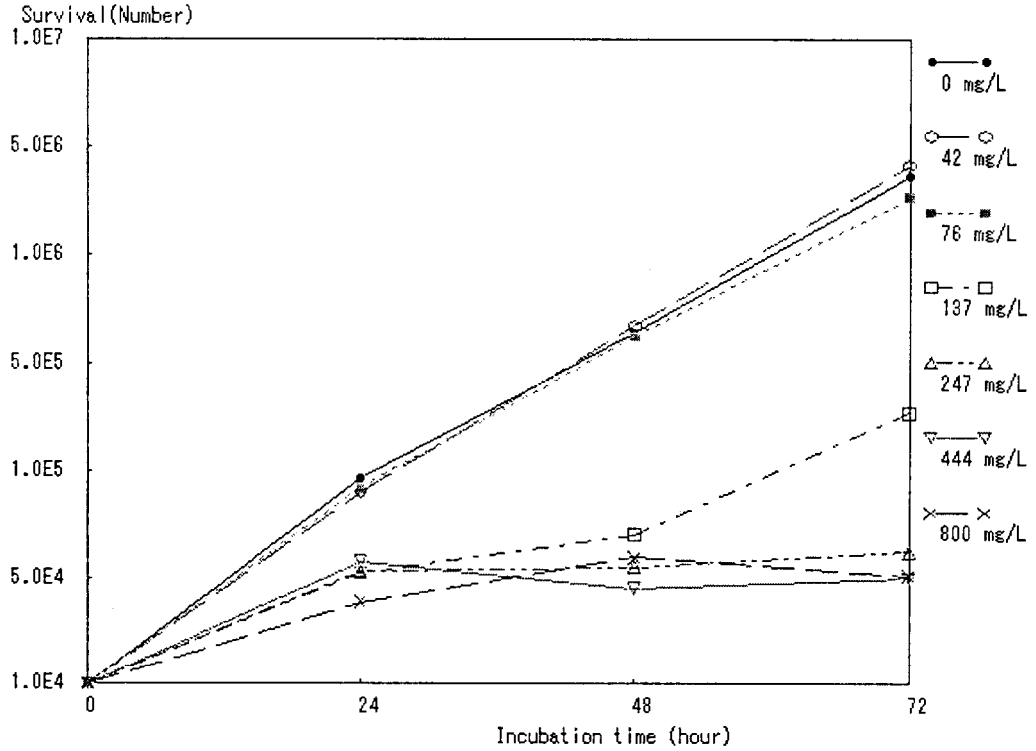
ErC50 (24-72) ＝ 155mg/L (95%信頼区間：143mg/L～168mg/L)

無影響濃度 (NOEC(速度法 24-72)) ＝ 76mg/L

(上記濃度は、全て設定濃度に基づく値)

2，2，6，6－テトラメチル－4－ヒドロキシピペリジン（CAS. 2403-88-5）

①生長曲線



Time course pattern of Algae Growth Test
2403885

②毒性値

0-72hErC50（設定値に基づく）＝120mg/L
0-72hNOECr（設定値に基づく）＝76mg/L

要　旨

試験委託者

環境庁

表　題

2,2,6,6-テトラメチル-4-ピペリジノールのオオミジンコ（*Daphnia magna*）に対する急性遊泳阻害試験

試験番号

NMMP／E09／2070

試験方法

本試験は、OECD 化学品テストガイドライン No.202「ミジンコ類、 急性遊泳阻害試験および繁殖試験」（1984年）に準拠して実施した。

1）被験物質　：2,2,6,6-テトラメチル-4-ピペリジノール
2）暴露方法　：止水式
3）供試生物　：オオミジンコ（*Daphnia magna*）
4）暴露期間　：48時間
5）連数　　：1濃度区に付き4連
6）生物数　　：20頭／1濃度区（1連に付き5頭で1濃度区20頭）
7）試験濃度　：対照区、 10.6mg/L、 19.1mg/L、34.3mg/L、61.7 mg/L、111.1 mg/L および200.0 mg/L（公比 1.8）
8）試験液量　：100 mL
9）照明　　：室内光、16時間明／8時間暗
10）試験水温　：20±1℃

結　果

1）24時間暴露後の結果

24時間半数遊泳阻害濃度(EiC50)＝130.1mg/L(95%信頼区間:111.1mg/L～200.0mg/L)

2）48時間暴露後の結果

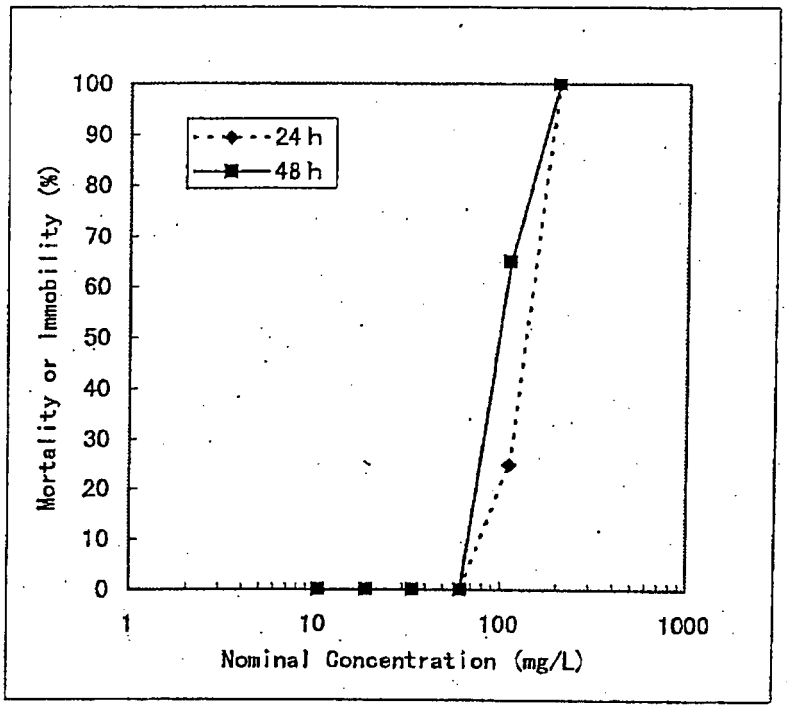
48時間半数遊泳阻害濃度(EiC50)＝100.1mg/L(95%信頼区間:61.7mg/L～200.0mg/L)

最大無作用濃度(NOECi)＝61.7mg/L

100%阻害最低濃度＝200.0mg/L

（上記濃度は、全て設定濃度に基づく値）

Figure 1　Concentration-Response Curve of 2, 2, 6, 6-Tetramethyl-4-piperidinol



要　旨

試験委託者

環境庁

表　題

2,2,6,6-テトラメチル-4-ピペリジノールのオオミジンコ（*Daphnia magna*）に対する繁殖阻害試験

試験番号

NMMP／E09／3070

試験方法

本試験は、OECD 化学品テストガイドライン No.202「ミジンコ類、急性遊泳阻害試験および繁殖試験」（1984年4月採択）の改訂版であるガイドライン No.211「オオミジンコ繁殖試験」（1997年4月提案）に準拠して実施した。

1)被験物質　：2,2,6,6-テトラメチル-4-ピペリジノール
2)暴露方法　：半止水式（週に3回、試験液の全量を交換）
3)供試生物　：オオミジンコ（*Daphnia magna*）
4)暴露期間　：21日間
5)試験濃度　：対照区、3.7mg/L、6.7mg/L、12.0mg/L、21.6mg/L、38.9mg/Lおよび70.0mg/L（公比1.8）
6)試験液量　：1容器（連）につき 80 mL
7)連数　：10容器（連）／濃度区
8)供試生物数　：10頭／濃度区（1連につき1頭）
9)試験水温　：20±1℃
10)照明　：室内光、16時間明／8時間暗
11)被験物質の分析　：GC法

結　果

1)試験液中の被験物質濃度

実測濃度が設定濃度の±20%以内であったので結果の算出には設定濃度を用いた。

2) 21 日間の親ミジンコの半数 致死濃度 (LC50) ＝ 70mg/L 以上

3) 21 日間の 50% 繁殖阻害濃度 (ErC50)

＝ 46.2mg/L (95%信頼区間 : 38.6mg/L～57.7mg/L)

4) 21 日間の最大無作用濃度(NOECr) ＝ 3.7mg/L

5) 21 日間の最小作用濃度(LOECr) ＝ 6.7mg/L

(上記濃度は、設定濃度に基づく値である)

Figure 1 Cumulative Numbers of Dead Parental *Daphnia*

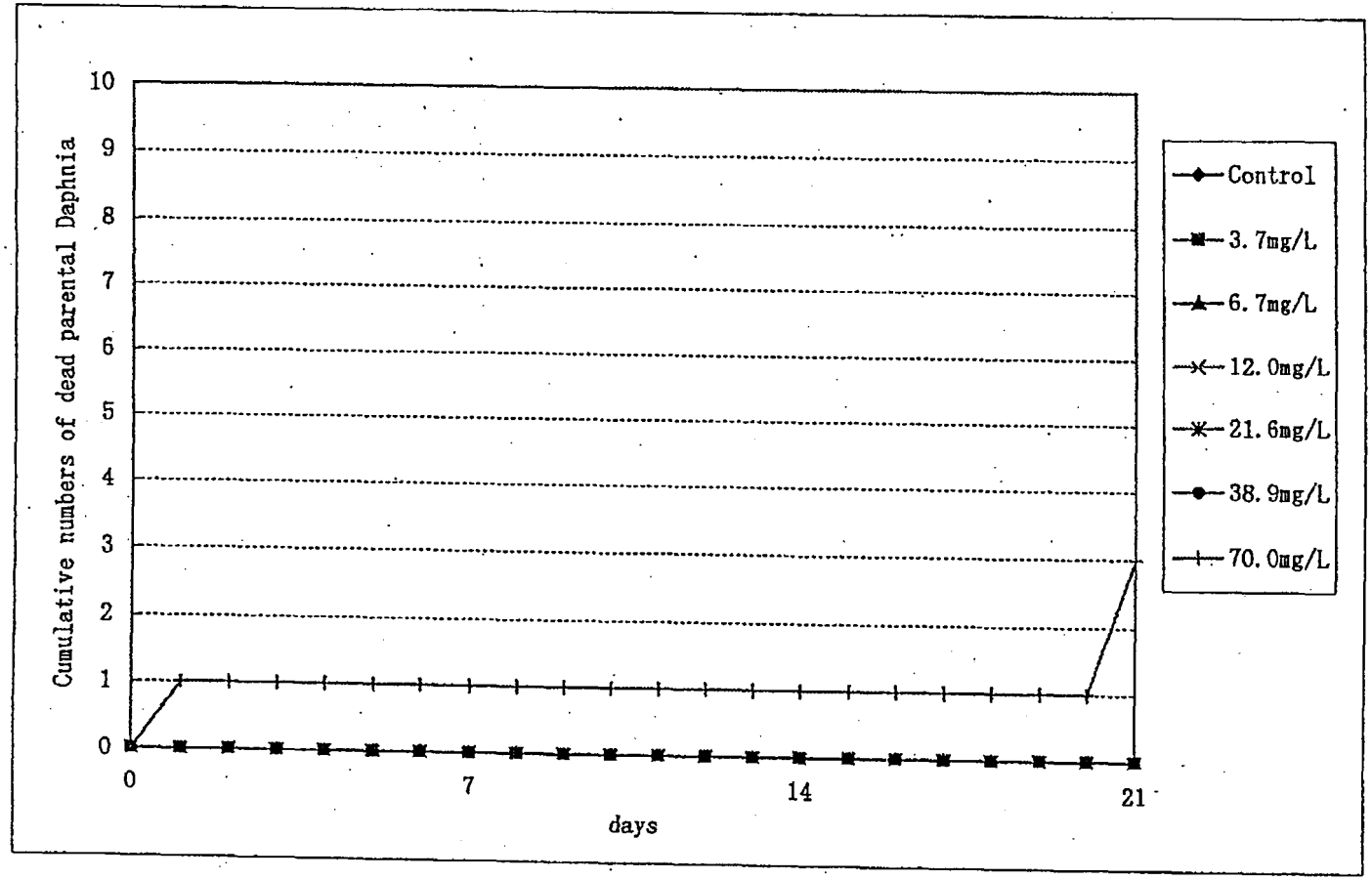
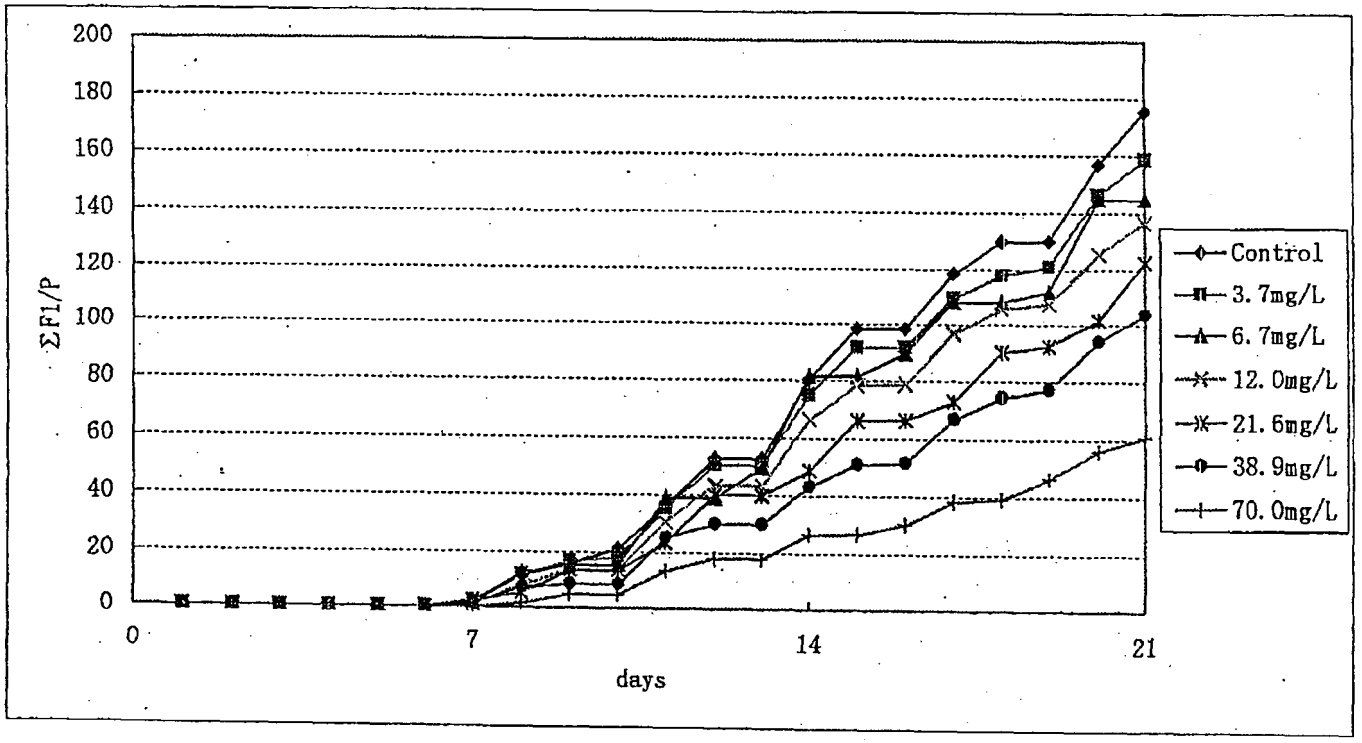


Figure 2 Mean Cumulative Numbers of Juveniles Produced per Adult (ΣF1/P) during 21 days



要　旨

試験委託者

環境庁

表　題

2,2,6,6-テトラメチル-4-ピペリジノールのヒメダカ（*Oryzias latipes*）に対する急性毒性試験

試験番号

ＮＭＭＰ／Ｅ０９／４０７０

試験方法

本試験は、OECD 化学品テストガイドライン No.203「魚類毒性試験」（1992年）に準拠して実施した。

被験物質	：2,2,6,6-テトラメチル-4-ピペリジノール
方式	：半止水式（24時間毎に換水）
供試生物	：ヒメダカ（*Oryzias latipes*）
試験濃度	：対照区、9.5mg/L、17.1mg/L、30.9mg/L、55.6mg/L、100.0mg/L および pH 調整（中和）した100.0mg/L（設定濃度）
暴露期間	：96 時間
試験液量	：3.0L
生物数	：10 尾／濃度区
照明	：室内光、16 時間明／8 時間暗
ｴｱﾚｰｼｮﾝ	：なし
温度	：24±1℃

結　果

試験の結果、2,2,6,6-テトラメチル-4-ピペリジノールの設定濃度に基づく 96 時間の半数致死濃度（LC50）は 100.0mg/L 以上であった。

また、pH 調整（中和）した試験液の 96 時間の半数致死濃度（LC50）も 100.0mg/L 以上であった。

Figure 1-1 Concentration-Response Curve of 2, 2, 6, 6-Tetramethyl-4-piperidinol Mortality in Orange killifish (*Oryzias latipes*)

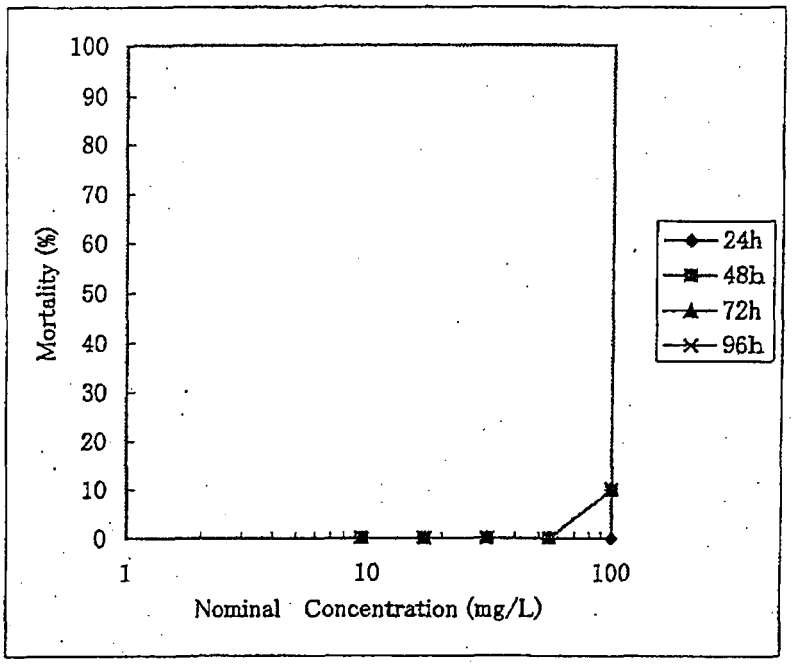
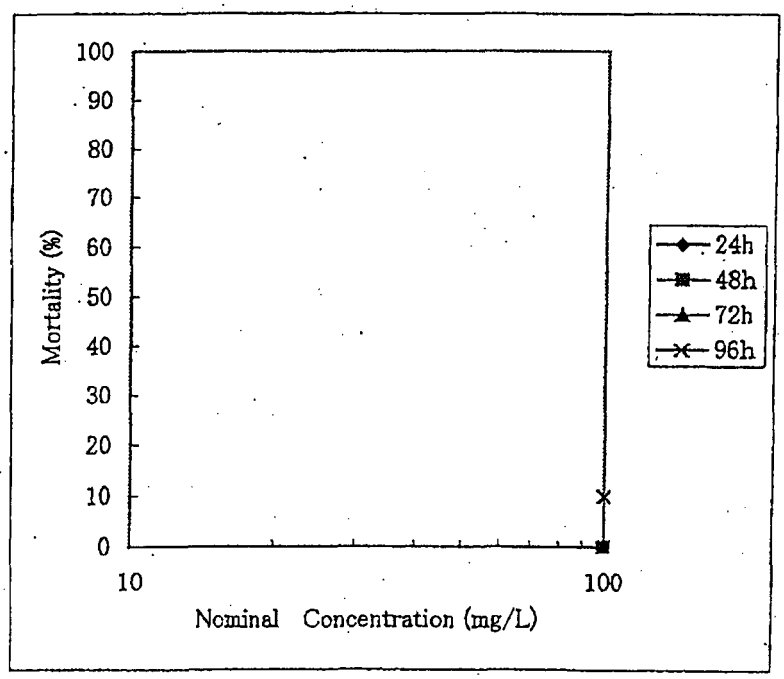
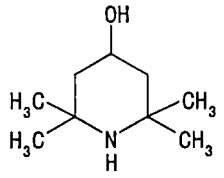


Figure 1-2 Concentration-Response Curve of Neutralized 2, 2, 6, 6-Tetramethyl-4-piperidinol Mortality in Orange killifish (*Oryzias latipes*)



SIDS INITIAL ASSESSMENT PROFILE

CAS No.	2403-88-5
Chemical Name	2,2,6,6-Tetramethylpiperidin-4-ol
Structural Formula	

RECOMMENDATIONS

The chemical is currently of low priority for further work.

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

There is no available information on toxicokinetics and metabolism of this substance. Oral LD_{50} of rats was 1482 mg/kg for males and 1564 mg/kg for females [OECD TG 401]. The major toxic signs were decreased locomotor activity, mydriasis and blepharoptosis, and tissue damages in the stomach and duodenum in both sexes. Dermal LD_{50} of rats was more than 2000 mg/kg. This substance is highly irritating to skin in rabbits [OECD TG 404], and it can be expected to cause serious damage to eyes but the study has not been performed. It has a moderate to strong grade of skin-sensitizing (contact allergenic) potential in guinea pigs [OECD TG 406].

In a (oral) combined repeat dose and reproductive/developmental study [OECD TG 422] rats received 0, 60, 200 or 600 mg/kg for at least 41-days. Animals died at 600 mg/kg (3/12 male, 1/12 female). Pathological changes were only observed in these animals; tissue damage to the gastro-intestinal tract, stomach and kidneys. The only effects seen at 60 and 200 mg/kg were drooping of the upper eyelid and dilation of the pupil in a dose related manner. A LOAEL of 60 mg/kg is identified for these clinical signs of toxicity. A NOAEL could not be identified.

In the above screening test [OECD TG 422], the substance was given from 14 days before mating to 20 days after mating in males, and to day 3 of lactation in females. In the 600 mg/kg group, the mean estrous cycle was prolonged with continuous diestrous in three females. With regard to the effects on neonates, viability and body weight on day 4 of lactation were decreased in the 600 mg/kg group. These effects are secondary non-specific consequence of systemic toxicity. The NOEL for reproductive /developmental toxicity was considered to be 200 mg/kg/day.

As for the genotoxicity, this substance was not mutagenic in bacteria [OECS TG 471 and 472]. An increase in chromosome aberrations in Chinese hamster lungs cells without S9 [OECD TG 473], were considered to be due to cytotoxicity and the study was considered to be "equivocal." A negative result was obtained in a rat bone marrow micronucleus assay [OECD TG 474]. Thus, on the basis of the available data, 2,2,6,6-tetramethylpiperidin-4-ol is not considered to be an *in vivo* genotoxicant, as the questionable genotoxicity observed *in vitro* is not expressed *in vivo*.

Environment

The generic fugacity model (Mackey level III) shows that if this substance is released into water, ca. 100% of this

substance is expected to stay in water due to the high solubility in water (> 100 g/L at 25°C, pKa 9.92 at 25°C). However as the substance is cationic form in the environment, it is likely that a certain portion of the substance is adsorbed in the sediment. This substance is not readily biodegradable (OECD TG 301C: 0 - 2% after 28 days) or hydrolyzed at pH 4, 7 and 9 at 50°C. But, it is expected to have low potential for bioaccumulation based on a low Log Pow (0.24) and a measured BCF of less than 5.7.

This substance has been tested in a limited number of aquatic species including fish, daphnia and algae. LC_{50} of the acute toxicity (96 h) for fishes (Medaka and Zebrafish) are 237 mg/L and > 1000 mg/L, respectively. A prolonged toxicity test using Medaka resulted in a LC_{50} (14 d) of 88.1 mg/L. The acute (immobility) and chronic data (reproduction) for daphnia were 100.1 mg/L for EC_{50} (48 h), and 46.2 mg/L for EC_{50} (21 d) and 3.7 mg/L for NOEC (21 d reproduction). The toxicity to *Selenastrum capricornutum* and *Scendedesmus subspicatus* of aquatic plants (algae) were 155 mg/L for EC_{50} (72 h) and 76 mg/L for NOEC (72 h), and 158 mg/L for EC_{50} (72 h) and 10 mg/L for NOEC (72 h), respectively. A predicted no-effect concentration (PNEC) of 0.037 mg/L for the aquatic organisms was calculated from the chronic NOEC for daphnia using an assessment factor of 100, because two chronic data (daphnia and algae) were available.

Exposure

This substance is used exclusively as an intermediate in synthesis of light stabilizer 'HALS' (Hindered Amine Light-Stabiliser) for plastics. The production volume in Japan was ca. 2,500 tons/year, while estimated global production was ca. 8,000 tons/year in 1999.

Workers may be exposed to this substance at production sites and user sites in industries. The production process is fully closed, but in packing and unpacking work, inhalation and dermal exposure is possible. Since this substance may cause irritation, corrosion and sensitization to the skin, a worker is allowed to work only after being equipped with appropriate protection implements at the workplace. Therefore, the amounts of exposure to a worker of this substance in the workplace would be practically low.

Consumer exposure is considered as follows. The amount of HALS in final consumer products, e.g. plastics is estimated to be less than 1.0%. The content of the substance itself in the consumer products should be far below that. Then exposure by the residues to a consumer through product surfaces would be very low.

During production and use in Japan, only the aquatic release of this substance from the production site seems to be possible. Although this substance is not readily biodegradable or hydrolysable, the bioaccumulation potential of this substance is low.

NATURE OF FURTHER WORK RECOMMENDED

No recommendation based on the prerequisite of negligible human exposure and environmental release.

要　旨

試験委託者
環境庁

表　　題
5-エチリデン-2-ノルボルネンの藻類(*Selenastrum capricornutum*)に対する生長阻害試験

試験番号
92065

試験方法
本試験は、OECD化学品テストガイドライン No.201「藻類生長阻害試験」(1984年)に準拠して実施した。

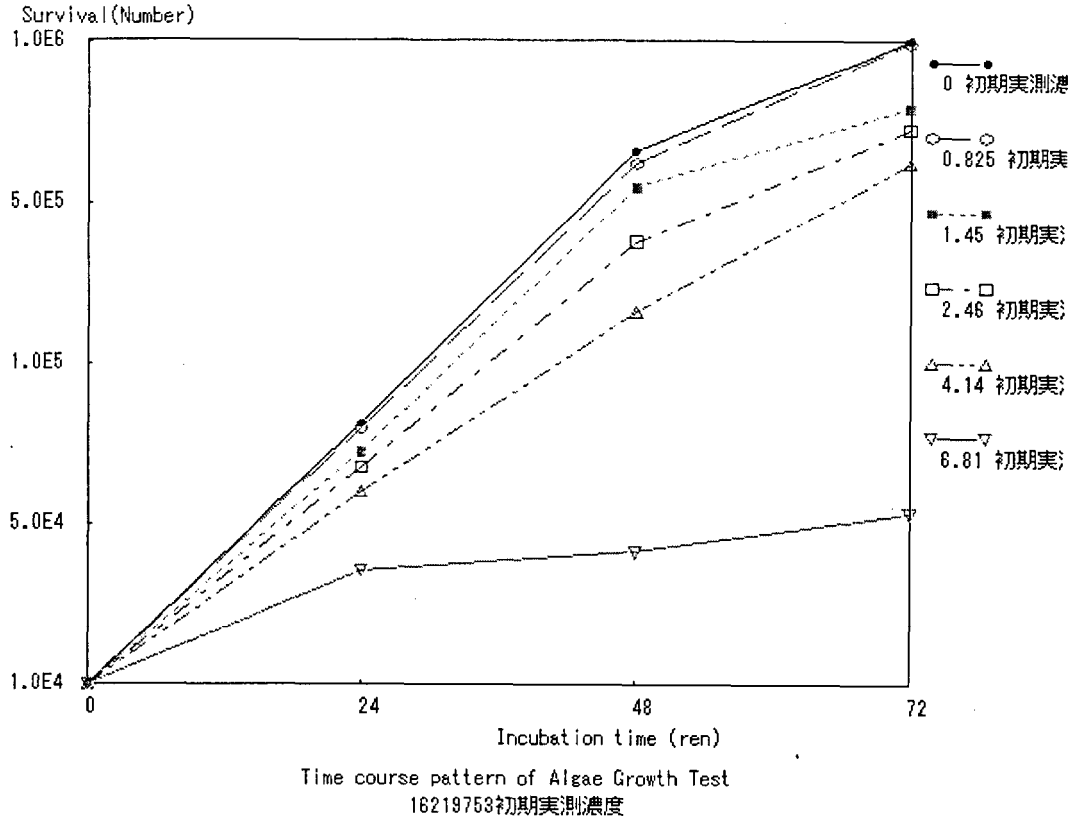
1) 被験物質：5-エチリデン-2-ノルボルネン
2) 試験生物：*Selenastrum capricornutum* (ATCC 22662株)
3) 初期細胞濃度：1×10^4 細胞/mL
4) 暴露期間：72時間
5) 培養方式：振とう培養 (100 rpm)
6) 試験濃度：33.4、19.6、11.6、6.80、4.00 mg/L(公比：1.7)、助剤対照区及び対照区
7) 連　　数：1試験区に付き3連
8) 試験液量：1試験容器(1連)に付き100 mL
9) 試験水温：23±2℃
10) 照　　明：4,000～5,000 lux (連続照明)
11) 試験液中の被験物質の分析：高速液体クロマトグラフィー (HPLC)
(暴露開始時、暴露終了時)

結　　果

1) 生長曲線下の面積の比較による50%生長阻害濃度(E_bC50)及び最大無作用濃度(NOEC)
E_bC50(0-72h)＝2.61 mg/L (95%信頼限界：2.15 ～ 3.18 mg/L)
NOEC＝0.852 mg/L
2) 生長速度の比較による50%生長阻害濃度(E_rC50)及び最大無作用濃度(NOEC)
E_rC50(24-48h)＝4.28 mg/L
NOEC＝1.45 mg/L
E_rC50(24-72h)＝5.31 mg/L
NOEC＝0.852 mg/L
(上記濃度は、全て測定濃度に基づく)

5－エチリデン－2－ノルボルネン（CAS. 16219-75-3）

①生長曲線



Time course pattern of Algae Growth Test
16219753初期実測濃度

②毒性値

0-72hErC50（初期実測値に基づく）＝4.9mg/L
0-72hNOECr（初期実測値に基づく）＝0.78mg/L

要　旨

試験委託者

環境庁

表　　題

5-エチリデン-2-ノルボルネンのオオミジンコ(*Daphnia magna*)に対する急性遊泳阻害試験

試験番号

92066

試験方法

本試験は、OECD化学品テストガイドライン No.202「ミジンコ類、急性遊泳阻害試験及び繁殖試験」(1984年)に準拠して実施した。

1) 被験物質：5-エチリデン-2-ノルボルネン
2) 試験生物：オオミジンコ(*Daphnia magna*)
3) 生物数：20頭／試験区(1連に付き5頭で1試験区20頭)
4) 暴露期間：48時間
5) 暴露方式：止水式(ガラス製板を用いた密閉式)
6) 試験濃度：5.00、2.78、1.54、0.857、0.476 mg/L(公比：1.8)、助剤対照区及び対照区
7) 連　　数：1試験区に付き4連
8) 試験液量：1試験容器(1連)に付き約250 mL
9) 試験水温：20±1℃
10) 照　　明：室内光、16時間明／8時間暗
11) 試験液中の被験物質の分析：高速液体クロマトグラフィー(HPLC)
(暴露開始時、暴露終了時)

結　　果

1) 24時間暴露後の結果
24時間半数遊泳阻害濃度(EiC50)＝3.34 mg/L (95%信頼限界：2.78～5.00 mg/L)
2) 48時間暴露後の結果
48時間半数遊泳阻害濃度(EiC50)＝3.34 mg/L (95%信頼限界：2.78～5.00 mg/L)
最大無作用濃度(NOECi)＝1.54 mg/L
100%阻害最低濃度＝5.00 mg/L
(上記濃度は、全て設定濃度に基づく)

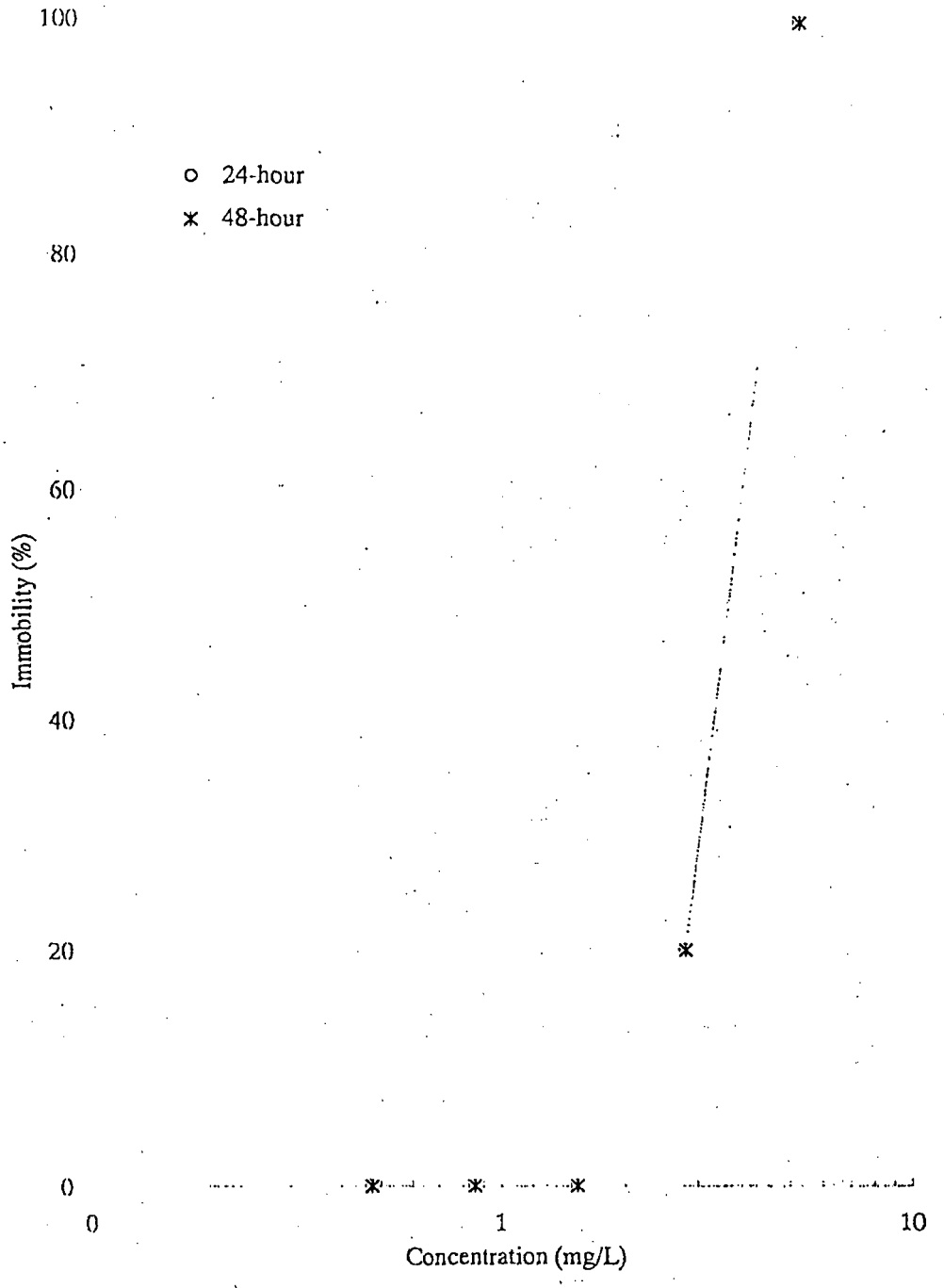


Figure 1. Concentration - toxicity curve of 5-ethylidine-2-norbornene in *Daphnia ma*

要　旨

試験委託者

環境庁

表　　題

5-エチリデン-2-ノルボルネンのオオミジンコ(*Daphnia magna*)に対する繁殖阻害試験

試験番号

92067

試験方法

本試験は、OECD化学品テストガイドライン No.202「ミジンコ類、急性遊泳阻害試験及び繁殖試験」(1984年4月採択)の改訂版であるガイドラインNo.211「オオミジンコ繁殖試験」(1997年4月提案)に準拠して実施した。

1) 被験物質：5-エチリデン-2-ノルボルネン
2) 試験生物：オオミジンコ(*Daphnia magna*)
3) 生物数：20頭／1試験区(1連に付き5頭で1試験区20頭)
4) 暴露期間：21日間
5) 暴露方式：半止水式(毎日試験液を交換、ガラスシャーレを用いた密閉式)
6) 試験濃度：3.20、1.88、1.11、0.651及び0.383 mg/L(公比：1.7)、助剤対照区及び対照区
7) 連数：1試験区に付き4連
8) 試験液量：1試験容器(1連)に付き約1300 mL
9) 試験水温：20±1℃
10) 照明：16時間明(1,200 lux以下)／8時間暗
11) 試験液中の被験物質の分析：高速液体クロマトグラフィー (HPLC)
(0、1、7、8、14及び15日目)

結　　果

1) 21日間の親ミジンコの50%致死濃度(LC50)
>2.57 mg/L
2) 21日間の50%繁殖阻害濃度(EC50)
=2.41 mg/L
3) 最大無作用濃度(NOEC)
=1.51 mg/L
4) 最小作用濃度(LOEC)
=2.57 mg/L

(上記濃度は、全て測定濃度に基づく)

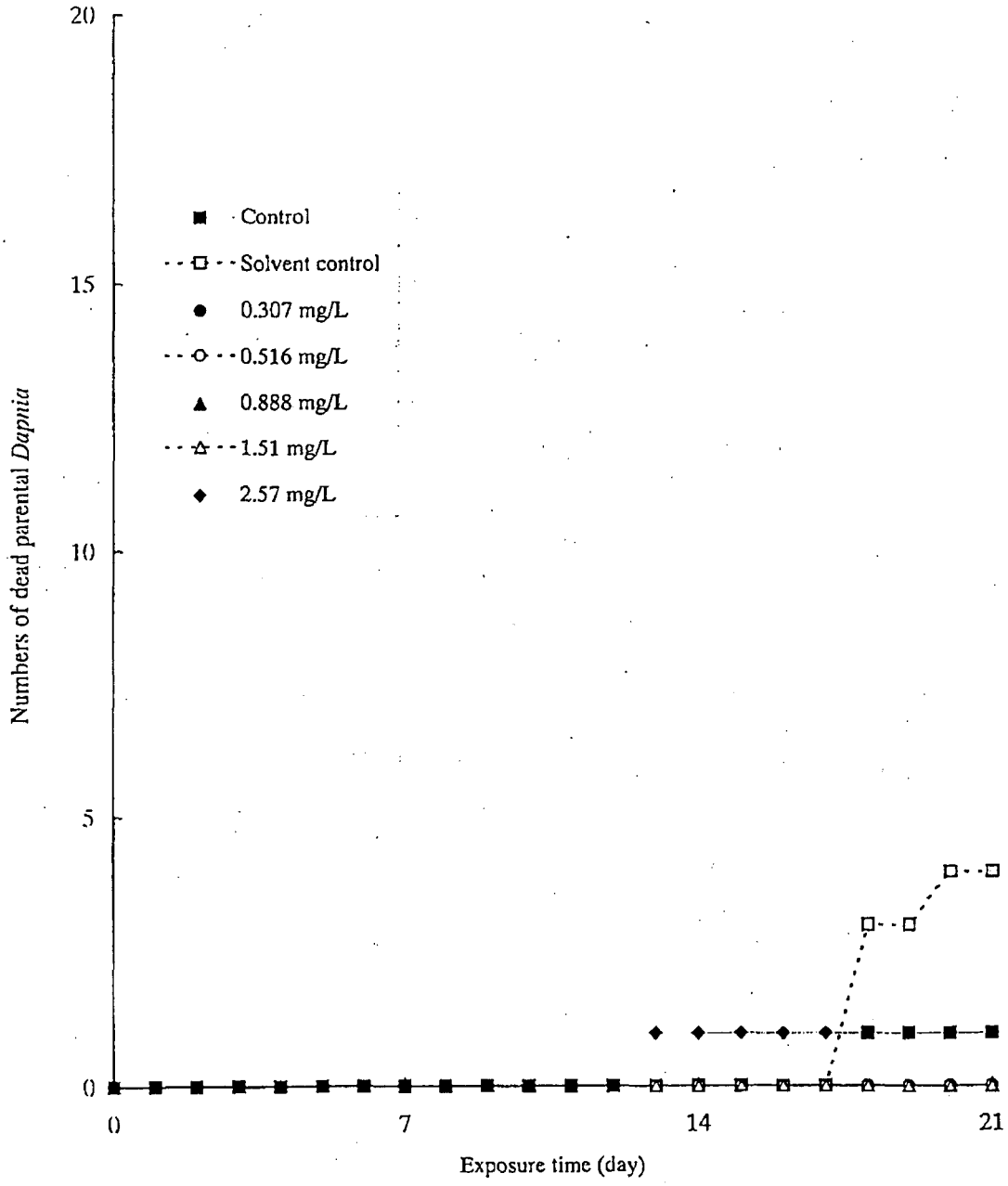


Figure 1. Cumulative numbers of dead parental *Daphnia*.

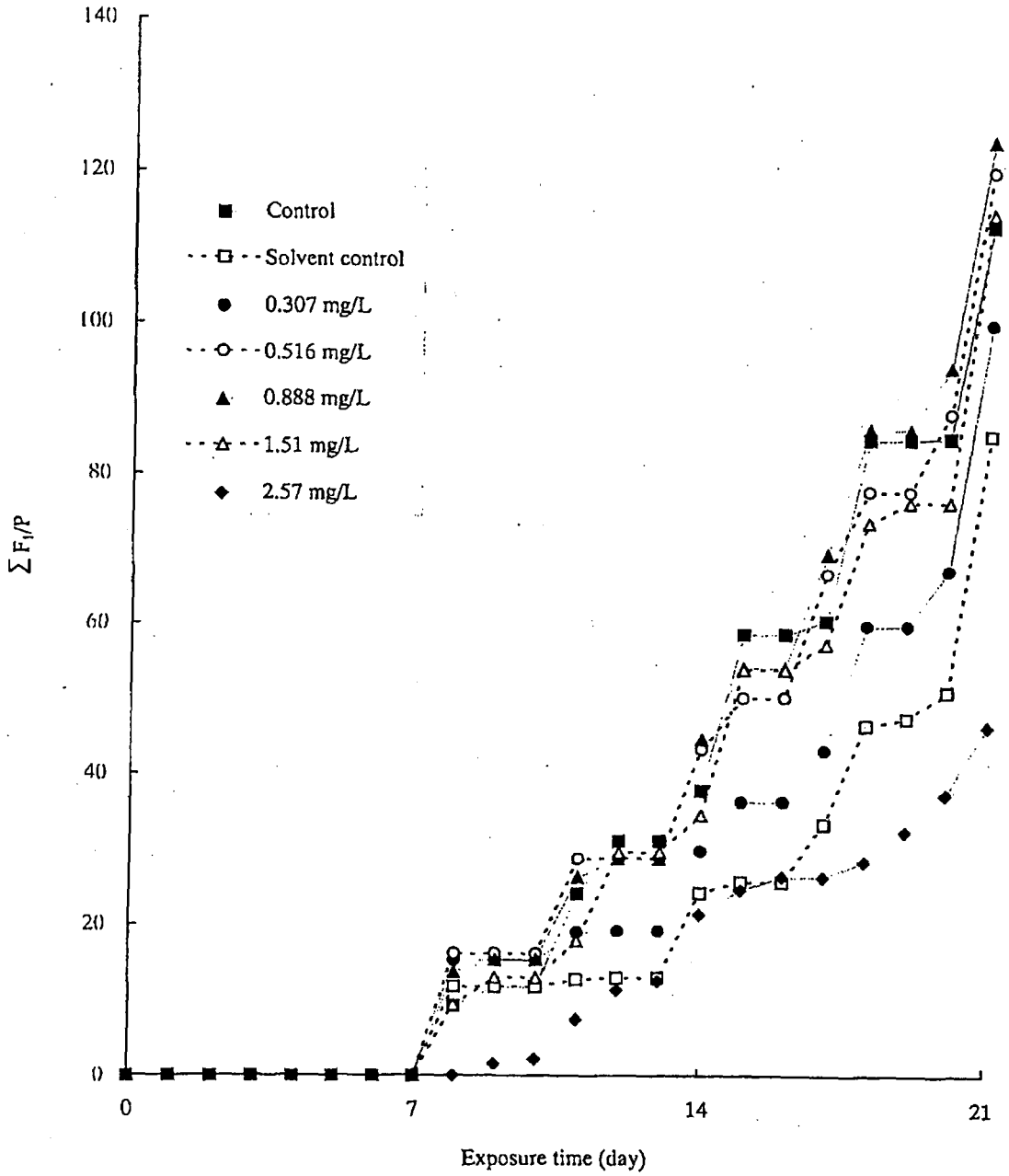


Figure 2. Mean cumulative numbers of juveniles produced per adult ($\Sigma F_1/P$).

要　旨

試験委託者

環境庁

表　　題

5-エチリデン-2-ノルボルネンのヒメダカ(*Oryzias latipes*)に対する急性毒性試験

試験番号

92068

試験方法

本試験は、OECD化学品テストガイドライン No.203「魚類急性毒性試験」(1992年)に準拠して実施した。

1) 被験物質：5-エチリデン-2-ノルボルネン
2) 試験生物：ヒメダカ(*Oryzias latipes*)
3) 生物数：10尾／1試験区(1連に付き5尾で1試験区10尾)
4) 暴露期間：96時間
5) 暴露方式：半止水、密閉式(試験液調製後16時間目と8時間目に試験液を交換)
6) 試験濃度：20.0、14.3、10.2、7.29、5.21 mg/L(公比：1.4)、助剤対照区及び対照区
7) 連数：1試験区に付き2連
8) 試験液量：1試験容器(1連)に付き3.4 L
9) 試験水温：24±1℃
10) 照明：室内光、16時間明／8時間暗
11) エアレーション：なし
12) 試験液中の被験物質の分析：高速液体クロマトグラフィー(HPLC)
[試験液調製時(暴露開始時、16時間後)、換水前(16時間後、24時間後)]

結　　果

1) 96時間の半数致死濃度 (LC50) ＝7.00 mg/L (95%信頼限界：6.17～8.51 mg/L)
2) 0%死亡最高濃度＝4.41 mg/L
3) 100%死亡最低濃度＝8.51 mg/L

(上記濃度は、全て測定濃度に基づく)

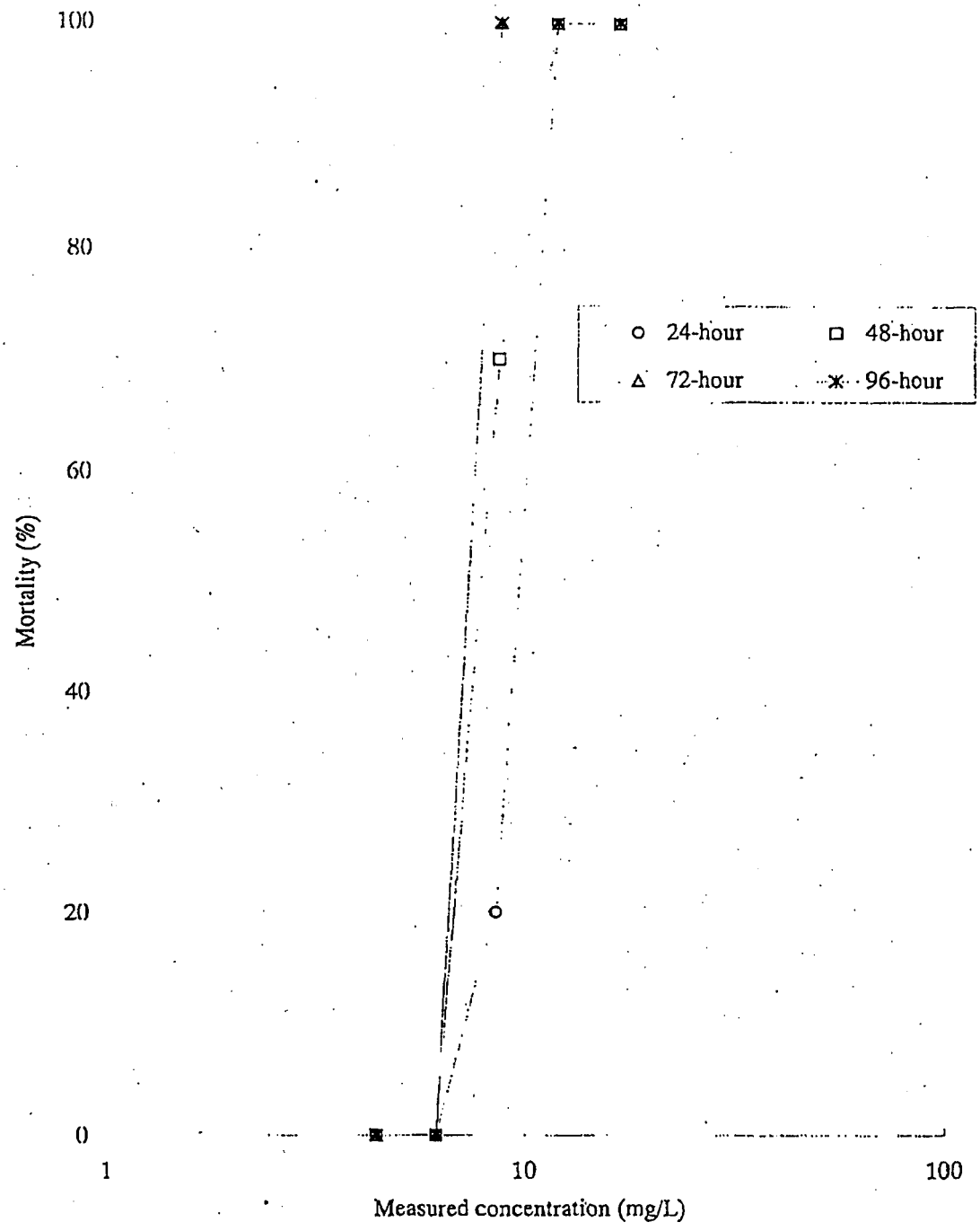
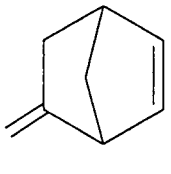


Figure 1. Concentration - toxicity curve of 5-ethylidine-2-norbornene in orange killifish (*Oryzias latipes*).

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	16219-75-3
Chemical Name	5-Ethylidene-2-norbornene
Structural Formula	

RECOMMENDATIONS

The chemical is currently of low priority for further work.

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

Ethylidene norbornene (ENB) has a relatively low degree of acute toxicity in several species via oral (LD_{50}: 2276-5071 mg/kg), dermal (LD_{50}: >7168 mg/kg), and inhalation (LC_{50}: 13.3-14.8 mg/L or 2717-3015 ppm) routes of administration. The substance is a mild irritant to skin and is a slight eye irritant to rabbits. There are no data available on skin sensitization. Repeated dose toxicity data include one 28-d oral (gavage) study and 3 subchronic inhalation studies up to 14-wk in duration. In the 28-d repeated oral dose study [TG 407], relative kidney weights were increased in rats of both sexes given 100 mg/kg/d. Histopathological examination revealed increased hyaline droplets in proximal tubular epithelium of the kidney, and hypertrophy of follicular epithelium, as well as a decrease in colloid or irregularly shaped follicles in the thyroids of males given 4 mg/kg/d or more ENB. Hypertrophy of thyroid follicular epithelium and a decrease in colloid were also observed in females given 100 mg/kg/d. The LOAEL of ENB in the 28-d repeated dose study was reported as 4 mg/kg/d for males, and the NOAEL was 20 mg/kg/d for females. Because the male rat kidney effects are consistent with alpha-2u-globulin nephropathy they are not relevant to humans. The mechanism producing thyroid effects in rats has little or no relevance to humans. Therefore, the oral NOAEL for systemic effects other than thyroid and kidney is 20 mg/kg/d, based on reduced body weight of females in the 100 mg/kg group. In inhalation exposure studies in rats, the major toxicity also appeared in the thyroid. For the most recent rat study, the NOAEL was reported to be 5 ppm based on thyroid effects. Other than the thyroid, no exposure related lesions were observed at concentrations up to 149 ppm. Because the increased relative liver weights were seen in both sexes at 149 ppm, the inhalation NOAEL based on effects other than thyroid is considered to be 25 ppm. ENB was not mutagenic with and without an exogenous metabolic activation system in bacteria and mammalian cells *in vitro* [OECD TG 471, 472, 473]. The chemical induced neither chromosomal aberrations nor sister chromatid exchanges in mammalian cells in culture. It also did not induce dominant lethal mutation in rats. There are two key studies that evaluated reproductive and developmental toxicity. One is an oral reproductive / developmental toxicity screening test [OECD TG 421], and the other is an inhalation development toxicity (teratogenicity) study. In the OECD TG 421study conducted in rats administered 0, 4, 20, and 100 mg/kg/day of ENB, a prolongation of the gestation period was noted in the 100 mg/kg/d group compared to controls but was within the normal historical range for the laboratory. The implantation and delivery indices were significantly lower in the 100 mg/kg/d group compared to controls. No other changes attributable to the compound were observed in any parameters including the mating index, the fertility index, the gestation index, number of corpora lutea, parturition state and lactation behavior. The total number of births and number of live offspring on

day 4 of lactation were decreased in the 100 mg/kg/d group. Among the pups, no other changes attributable to the compound were observed in parameters including the sex ratio, the live birth index, and the viability index on day 4, necropsy findings or external examination. Based on these findings, the oral NOAEL for reproductive/ developmental toxicity was 20 mg/kg/d. A teratogenicity study was conducted in rats exposed by inhalation to 0, 25, 100 and 354 ppm ENB (0, 123, 492, 1740 mg/m^3) during days 6-15 of pregnancy. There was no maternal mortality. Maternal body weights, body weight gain, and food consumption were reduced over the exposure period at 100 and 354 ppm, with partial or complete recovery post exposure. Increased relative liver weights were measured for the 100 and 354 ppm groups. There were no increases in the incidence of malformations or external and visceral variations. Three skeletal variants (bilobed 12th thoracic centrum, split 12th thoracic centrum, and poorly ossified second sternabra) were increased at 354 ppm, and one (bilobed 12th thoracic centrum) was increased at 100 ppm. Thus, fetotoxicity (skeletal variants) was seen in the 100 and 354 ppm group litters in the presence of maternal toxicity. For both maternal and developmental toxicity, 25 ppm (123 mg/m^3) was a NOAEL.

Environment

ENB has been tested for aquatic toxicity in three trophic levels including fish, daphnia and algae. For acute toxicity, a 72hEC_{50} of 2.61 mg/L and a 96hEC_{50} of 3.68 mg/L for algae (OECD TG 201, *Selenastrum capricornutum* biomass), 48hEC_{50} values of 3.34 and 7.3 mg/L for daphnid (OECD TG 202, *Daphnia magna*, immobilization), and for fish a 96hLC_{50} of 7.0 mg/L (OECD TG 203, *Oryzias latipes*) and of 7.6 mg/L (*Brachydanio rerio*) were available. In chronic studies, a 72-h NOEC of 0.852 mg/L in *Selenastrum* (OECD TG 201,biomass) and a 21-d NOEC of 1.51 mg/L in *Daphnia magna* (OECD TG 211, reproduction) were reported, respectively. The EC_{50} of multiple studies in different species of fish and in the daphnia and algae were consistent, however alga was the most sensitive among three trophic levels.

Exposure

The production volume of ENB is estimated to be ca. 20,000 tonnes/year in Japan, and ca. 54,000 tonnes/year worldwide; major producers are located in Japan, EU and the United States. ENB is a bicyclic diene compound used as a co-polymer in the production of ethylene-propylene diene monomer (EPDM) elastomers. ENB is produced in a closed system by a limited number of companies. At one company in Japan, ENB was not detected in the wastewater, rain sewer or in the air at the borderline of the Japanese manufacturing plant site. Data from one US manufacturer indicates 979 pounds (445 kg) per year are released as fugitive emissions to the atmosphere during production and storage of ENB. There are no discharges to soil or water (data reported to USEPA Toxic Release Inventory in 2000). The product use pattern can be described as "closed systems; non-dispersive use in the chemical industry as an intermediate." The major use of ENB is in EPDM rubber production, which occurs under controlled conditions. Data from a US and European EPDM plant have been obtained, and Mckay Level III fugacity calculations indicate "nanogram" quantities of ENB will be present in water that enters the waste water treatment plant where most will be released to atmosphere prior to discharge. Based on physical/chemical properties [log Pow (3.82), water solubility (80 mg/L), vapor pressure (5.6 hPa), and Henry's Law constant (>5 atm·m^3·mol^{-1})] ENB released in the environment is readily volatile and will rapidly partition to the air (Fugacity level I calculations). ENB is not readily biodegradable (OECD 301C) and is expected to be slightly to moderately mobile in soil based on calculated soil adsorption coefficients (log Koc) ranging from 2.96 to 3.01.Measured BCF of 61-160 in Carp confirm low potential for bioaccumulation (OECD 305C). If released into water, ENB is expected to volatilize to the atmosphere. The atmospheric half-life of ENB is estimated to be 52 minutes. Vapor phase ENB will be degraded in the atmosphere by reaction with photochemically produced hydroxy radicals and ozone molecules.

Occupational exposure to ENB may occur through inhalation and dermal contact with this substance at workplaces where ENB is produced and used. ACGIH and US/OSHA set a ceiling limit at 5 ppm (25 mg/m^3) for ENB to protect against eye and skin irritation. Since ENB is produced in a closed system the potential for exposure is primarily during maintenance operations and/or upset conditions. Workplace air monitoring in the EPDM production area has found full shift personnel exposures normally below 0.5 ppm with a range of <0.01 to 1.39 ppm. In the rubber production areas, potential for worker exposures exist in and around the distribution conveyors to the baling pits. Short-term area samples from open points in the system vary from 1 to 5 ppm. The exposure to the general population via the environment is theoretically possible through consumption of fish, which may accumulate this chemical to a limited degree. However, due to the anticipated short residence time of ENB in aquatic ecosystems,

chronic exposure of aquatic organisms is not expected. Another possible exposure route may be via migration of the chemical from food packaging polymers. However, estimation of worst case exposures revealed very low exposure levels which were considered insignificant.

NATURE OF FURTHER WORK RECOMMENDED

The chemical is currently of low priority for further work This conclusion is based on negligible human exposure and very low environmental releases.