AMVAC

received 4/2/02 AM by NOP

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March 26, 2002

National Organics Standards Board
c/o Mr. Robert Pooler, Agricultural Marketing Specialist
USDA/AMS/TM/NOP, Room 2510-So.
Ag Stop 0268, P.O. Box 96456
Washington, D.C. 20090-6456

Via Federal Express

Re: Petition to National Organics Standards Board (NOSB) for Addition of Synthetic Substance (Tetrahydrofurfuryl alcohol (THFA), CAS No. 97-99-4) to National List for Use in Organic Crop Production

Dear Mr. Pooler:

The Organic Foods Production Act of 1990, as amended, established a National List of allowed and Prohibited Substances (National List) which identifies the synthetic substances that may be used, and the nonsynthetic substances that cannot be used, in organic production and handling operations. The Act also provides a mechanism to petition the National Organics Standards Board to evaluate a substance for inclusion on or removal from the National List.

With this petition, and consistent with a previous request by the Organic Materials Review Institute (OMRI), AMVAC Chemical requests review of the pesticidal inert ingredient tetrahydrofurfuryl alcohol (THFA) for consideration on the Proposed National List of Organic substances for inclusion on:

- The list of synthetic substances allowed for use in organic crop production.

THFA is an inert ingredient used as a solvent in certain AMVAC [ ] [CBI-DELETED] products which are referenced in this attached petition. Among the many advantages of employing THFA in agricultural products, which are more fully detailed in the petition, are the following considerations:

- Food Additive: THFA is currently established by FDA (on EAFUS list) as a direct food additive;
- Tolerance Exemption: THFA is exempt from EPA tolerance for food uses ;
- Environmentally-acceptable solvent: THFA is broadly viewed as a low toxicity, non-mutagenic and non-carcinogenic solvent for use in agricultural and other products, with excellent environmental characteristics of high biodegradability and low environmental persistence ;
- Pharmaceutical Uses: THFA is approved for direct human contact in topical creams and lotions as an absorption enhancer/solvent, one such marketed product being *Biosal Arthritis Cream*. Furthermore, THFA is under evaluation for further human exposure as a solvent in injectable drugs ;
- Risk Assessments: Various risk assessments completed by governmental Agencies have identified no concerns with THFA for human health or the environment; and,
- Non-target organisms: THFA has a low toxicity to non-target organisms with a very low use rate of 0.0005 oz THFA per ft^2.

AMVAC Chemical appreciates the opportunity to submit a petition for inclusion of THFA on the National List. We appreciate your efforts in reviewing such petitions of organic status. Please contact me if you have any questions regarding our petition.

Sincerely,

Darryl E. Brock

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AMVAC Chemical
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Enclosures: 4 (2 CBI, 2 CBI-deleted) [ ] [CBI-DELETED]

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AMVAC Chemical Corporation

March 26, 2002

PETITION TO NATIONAL ORGANICS STANDARDS BOARD (NOSB)
FOR ADDITION OF SYNTHETIC SUBSTANCE TO NATIONAL LIST
FOR USE IN ORGANIC CROP PRODUCTION

TETRAHYDROFURFURYL ALCOHOL (THFA)
CAS No. 97-99-4

PROCESS GUIDANCE referenced in preparation of this petition:

Submission of Petitions for Evaluation of Substances for Inclusion on or Removal from the National List of Substances Allowed and Prohibited in Organic Production and Handling. *Federal Register* 65:135 (13 July 2000), pp. 43260-43261.

Information to Be Included in a Petition. *National Organic Program webpage* (www.ams.usda.gov/nop/).

ITEM A
CATEGORY declaration of the substance petitioned for inclusion on the National List:

Category 1 -- Synthetic substance allowed for use in organic crop production.

ITEM B
REQUIRED PETITION ELEMENTS:

1. **The substance's common name:**

   Tetrahydrofurfuryl alcohol (THFA)
   CAS # 97-99-4

2. **The manufacturer's name, addresses and telephone number.**

   Great Lakes Chemical Corp. (Phone: 317/497-6100)
   One Great Lakes Blvd., P.O. Box 2200, West Lafayette, IN 47906

   Sigma-Aldrich (Phone: 414/273-3850)
   P.O. Box 355, Milwaukee, Wisconsin 53201

   Penn Specialty Chemicals (Phone: 901/320-4000)
   3324 Chelsea Avenue, Memphis, TN 38108

   Harcross Chemicals, Inc. (Phone: 913/321-3131)
   5200 Speaker Rd., Kansas City, KS 66110-2930

   Ashland Chemical Co. (Phone: 614/790-3333)
   P.O. Box 2219, Columbus, OH 43216

   Penta Manufacturing Company (Phone: 973/740-2300)
   50 Okner Pkwy., Livingston, NJ 07039-1604

Sithean Corporation (Phone: 520/524-2374)
630 North Craycroft Road, Tucson, AZ 90511

3. **The intended or current use of the substance such as use as a pesticide, animal feed additive, processing aid, nonagricultural ingredient, sanitizer or disinfectant.**

Current use: Pesticide *inert* ingredient (solvent used in [ ]) CBI-DELETED

4. **A list of the crop, livestock or handling activities for which the substance will be used. If used for crops or livestock, the substance's rate and method of application must be described. If used for handling (including processing), the substance's mode of action must be described.**

Crop Use: The inert ingredient is used in [ ] that have the following uses:

[CBI-DELETED

]

Not used in handling or processing, thus no mode of action presented.

5. **The source of the substance and a detailed description of its manufacturing or processing procedures from the basic component(s) to the final product. Petitioners with concerns for confidential business information can follow the guidelines in the Instructions for Submitting Confidential Business Information (CBI) listed in #13.**

Manufacturing and processing procedures are Confidential Business Information by the manufacturer and not available to AMVAC Chemical, the producer of the formulated product (which utilizes this solvent as an inert ingredient in some of its pesticide formulations). As a government agency, the NOSB may be able to obtain this information directly from the manufacturers listed in Item 2 above.

6. **A summary of any available previous reviews by State or private certification programs or other organizations of the petitioned substance.**

FDA: The FDA Center for Food Safety and Applied Nutrition (CFSAN) has responsibility for compiling the Priority-Based Assessment of Food Additives (PAFA) database; as a result, a review of data for THFA in support of its establishment by FDA as a food additive (see next section) would have been conducted. No such review was found on FDA publicly available resources. Contact with Mr. Robert Martin of FDA revealed that no risk assessment, *per se*, was conducted on THFA, but a review of supporting data was conducted in the mid-1970's.

EPA Inert Review for THFA: EPA has placed THFA on Inert List 3 (see Item 7 below) and is engaged in a reclassification process for inert ingredients used in pesticide products. About 41 of the approximately 1500 List 3 inert ingredients are widely used in organic agriculture. EPA's OPP has contracted with OPPT's

Structure Activity Team (SAT) to prepare toxicological and ecological assessments for these inerts. OMRI (the Organic Materials Review Institute) has informed our company that the Agency has recently communicated to the NOSB that List 3 materials have been preliminarily classified. Specifically, THFA has been placed in group "D," *viz.*, "Risk assessment, but likely acceptable." While it is thus anticipated that the EPA will reclassify THFA from List 3 (those of Unknown Toxicity) to List 4 (those of Minimal Hazard or Risk), it is not likely this decision will be made prior to the October 21, 2002 National Organics Rule implementation date.

EPA Inert Review Process: The EPA process for inert ingredient review has recently undergone change. On Nov. 29, 2001 OPP's Kerry Leifer released a listing of 147 inert ingredient tolerances found at 40 CFR 180.1001 (c) and (d), which may meet polymer exemption criteria in order to satisfy FQPA tolerance reassessment. THFA is not on this candidate list, as it is not a polymer. Nevertheless, the memorandum establishes that inerts expected to be low-risk could support Agency reviews based on only a minimum dataset (e.g., such as CAS number, trade name, etc.). On December 5, 2001, EPA confirmed this process with announcement of a new approach to screening inert ingredients via a tiered process, requiring less data and review for inerts anticipated to be of lower toxicity. OPP and OPPTS will coordinate reviews, with risk-assessment determinations to be made by a senior OPP interdisciplinary committee entitled the Inert Ingredient Focus Group. Proposals have also been received by EPA suggesting that it move to quickly approve inerts for pesticide use based on FDA food additive approvals already on record. Should EPA adopt this approach, THFA could be approved quickly. On February 6, 2002, EPA-OPP director Marcia Mulkey said that the Agency will soon issue a proposal on data required to assess such food use inerts, and indicated decisions can likely be made based on available scientific literature. This approach is now being employed in pilot reviews of 12 food-use inerts, and it is expected that 400-500 food use inerts will be confirmed safe by EPA. Even so, a proposed revision to 40 CFR 158 on inerts data requirements will not be adopted before early 2003. As a result, the review of THFA prior to implementation of the National Organics Rule is not a certainty. A decision by NOSB to place THFA on the National List would thus be needed to insure continued use of THFA as solvent for use with agrochemicals associated with organic production.

State of Washington Risk Assessment: The Washington Department of Agriculture (WSDA), under its Organic Food Program (OFP), maintains a Brand Name Materials List (BNML) as a service to organic producers, processors and handlers. Their BNML relied on inert ingredients reviewed and approval by WSDA under Chapter 16-160 WAC, *Registration of Brand Name Materials for Organic Food Production.* WSDA has been working to amend state organic rules to adopt the USDA National Organic Program Final Rule; on January 24, 2002 WSDA indicated further explanation of NOP impacts to their program will be forthcoming in the next several months. As this adoption occurs, the National List of Materials, including its listing of approved synthetic materials, will be the basis for accepting formulated products on the BNML. It is not anticipated that WSDA will find it necessary to conduct further risk assessments on THFA, should this inert be added to the National List (or be placed on EPA List 4 for inert ingredients).

OMRI Risk Assessment: The Organic Materials Review Institute (OMRI), a private certification program, has submitted to EPA a request re-classify THFA to Inerts List 4 so that it (and other inerts) may continue to be utilized in products appearing in the *OMRI Brand Name Products List.* Thus, OMRI has completed its internal assessment, based on information available, that THFA should continue to be used in organic products.

EPA Tolerance Assessment: TSCA Section 8(e) correspondence to EPA from Great Lakes Corporation (obtained from EPA by FOIA) dated 23 October 1991 indicates that Quaker Oats Chemical (now a division of Great Lakes) conducted studies in the 1970-1972 period in support of Pesticide Petition No. PP 2F1198 and submitted them under FFDCA Section 408(d). No pesticide products were registered, and the studies were then reviewed under Section 408(e), at the Administrator's initiative, and the petition renumbered PP 2E1198. The petition for exemption from tolerance was granted (40 CFR 180.1001(c), presented at Appendix I). A total of 11 studies have been identified in NPIRS associated with these actions, and a listing is presented in Appendix V. (NPIRS does not provide data summaries or Agency study reviews.)

Environmental Defense Scorecard: The Risk Assessment Values of Standards section of the Environmental Defense Fund Scorecard presents risk assessment information in two areas (full document included in Appendix IV):

- Inhalation cancer risk value (potency): Not a recognized or suspect carcinogen
- Ingestion cancer risk value (potency): Not a recognized or suspect carcinogen

7. Information regarding EPA, FDA, and State regulatory authority registrations, including registration numbers.

U.S. EPA and State: There are no pesticidal registrations of tetrahydrofurfuryl alcohol (per the NPIRS database). An exemption from tolerance was granted (40 CFR 180.1001(c)) under the petition number PP 2E1198 (originally PP 2F1198), as previously described under Item 6 (Appendix I).

U.S. EPA Inerts Listing: Tetrahydrofurfuryl alcohol is an approved inert for use in pesticide formulations and is on EPA Inerts List 3 "Inerts of Unknown Toxicity," i.e., those inerts without basis for inclusion on Lists 1, 2 or 4.

FDA Registrations: Tetrahydrofurfuryl alcohol appears in the FDA EAFUS database (Everything Added to Food in the United States), and in 21 CFR 172, 175 and 176 for Direct and Indirect Food Additives, as summarized in the FDA webpage abstract below and attached in Appendix I:

2001-JUN-08 -- **EVERYTHING ADDED TO FOOD IN THE UNITED STATES**

DOC TYPE	DOC NUM	MAINTERM	CAS RN OR OTHER CODE	REGNUM*
ASP	1464	TETRAHYDROFURFURYL ALCOHOL	000097-99-4	172.515 175.105 176.180** 176.210

*The REGNUM column above comprises the following 21 CFR sections:

CFR Reference	Title
172.515	Food additives permitted for direct addition to food for human consumption – Synthetic flavoring substances and adjuvants
175.105	Indirect food additives: Adhesives and components of coatings – Adhesives
176.180	Indirect Food Additives: Paper and Paperboard Components – Components of paper and paperboard in contact with dry food**
176.210	Indirect Food Additives: Paper and Paperboard Components – Defoaming agents used in the manufacture of paper and paperboard.

** While FDA webpage indicates THFA at 21 CFR 176.180, it is not present in 1 April 2001 edition.

8. The Chemical Abstract Service (CAS) number or other product numbers of the substance and labels of products that contains the petitioned substance.

CAS #	97-99-4
CAS # (former)	72074-94-3 ; 82853-20-1
CAS # (others)	22415-59-4 (R isomer) ; 57203-01-7 (S isomer)
EC #	202-625-6 & 603-061-00-7 (EINECS)
NIOSH/RTECS #	LU2450000
ICSC #	1159
FEMA #	3056
BRN #	102723
MDL #	MFCD00005372
Beilstein Index:	17(2), 106
Merck Index #	12,9353

Labels: While THFA is not labeled as a pesticide, it is included in [ ] that AMVAC Chemical manufactures and distributes, which are delineated below, and for which labels are appended in III: [CBI-DELETED]

[[CBI-DELETED]

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9. The substance's physical properties and chemical mode of action including:

(a) chemical interactions with other substances, especially substances used in organic production;

The specialty solvent THFA occurs in two isomeric forms: D-isomer (levorotary) and L-isomer (dextrorotary).[1] It is a colorless, clear, water-miscible, neutral, high-boiling, non-photochemically reactive solvent with a high flash point, high-boiling point, low freezing point, thermal stability and a high solvency for organic and inorganic materials. It's low volatility aids in retarding evaporation. The ACS CHEMCYCLOPEDIA describes it as an environmentally acceptable solvent (Appendix III). In addition to its use as an agricultural solvent and pesticide adjuvant, it has pharmaceutical applications as a transdermal absorption enhancer/solvent for compounding topical creams and lotions[2], and is employed in the Australian market in the product *Biosal Arthritis Cream* (Appendix III); furthermore, it has been tested for intravenous and intra-arterial injection for water-insoluble drugs[3]. Last, THFA is an FDA-approved direct food additive as a synthetic flavoring and adjuvant, as well as an indirect food additive as an adhesive, paperboard component and defoaming agent for paperboard. Its other uses include biocide carrier in industrial cleaners, coating remover (paints, inks, etc.), chemical intermediates, and electronics.

THFA technical synonyms (per NIH, CHEMID) and general information on THFA and related chemicals are presented in Appendix III.

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1 *Merck Index*, 13th edition, 2001.

2 Allen, Loyd V. Compounding Topical Dosage Forms: Ointments, Creams, Pastes and Lotions. *Current and Practical Compounding Information for the Pharmacist.* Paddock Laboratories, Inc. 1993. (Abstract included in this petition at Appendix VIII.)

3 Stelling, Mottu F, et al. Comparative hemolytic activity of undiluted organic water-miscible solvents for intravenous and intra-arterial injection. J.Pharm. Sci. Technol. 2000 Jan-Feb; 55(1): 16-23. (Abstract included in this petition at Appendix III.)

The interaction of THFA with substances used in organic production is essentially that of a solvent for naturally-occurring pesticides such as azadirachtin.

(b) toxicity and environmental persistence;

Organic production strives to maintain high quality food crops, while promoting use of lower toxicity inputs so as to preserve human health and to promote environmental balance. Crop protection aids, such as adjuvants and inert ingredients, are consistent with organic agriculture when they meet those requirements. An inert, such as THFA which is already employed in the pharmaceutical industry, is an approved food additive (both direct and indirect), and is already exempt from pesticide tolerance, is an inert demonstrating the low toxicity profile desired for organic inputs. This inert is a recognized environmentally-friendly solvent. It biodegrades in the environment – in soil and water – and thus promotes the ecological balance sought in organic production. That is, the possibility of groundwater contamination and accumulation in fish and other wildlife is obviated by its unavailability and lack of environmental persistence. Furthermore, its use as a solvent in the aforementioned agricultural products results in very low per application per acre use rates (8-22.5 oz use rate in products, and thus 6-17 oz THFA per acre, or 0.0005 oz THFA/ft^2); this contributes to low environmental availability and impact.

Lack of Environmental Persistence

As MSDS documents indicate, THFA is not persistent in the environment, but readily biodegrades in soil, sludge and water. Furthermore, it has an atmospheric half-life of 13 hours. The biodegradability of THFA is confirmed by one study that found that the microbe *Ralstonia eutropha* not only readily biodegrades THFA, but also tolerates it at concentrations as high as 200 mM.[4]

Those data indicate that THFA is a very benign solvent and is not expected to have – by itself – any substantial effect on beneficial arthropods or other non-target organism. This feature is highly desirable in the context of organic agriculture, where preservation of beneficial insects is critical for the management of pest complexes.

Limited Environmental Toxicity

Available data indicate low toxicity to environmental organisms. In aquatic systems, THFA was one of the solvents with very low toxicity (LC_{50}>10,000 ppm) to frog tadpoles, which not only suggests THFA may be a good solvent for use in toxicity testing of these amphibians, but is supportive of limited aquatic toxicological impact.[5] Similarly, in an insect study, THFA, at 0.25 .mu.L/insect [*sic*], was one of the solvent tests which was not toxic to houseflies, stableflies and tsetse flies. This is supportive of limited toxic effects to beneficial insects important to organic agriculture.[6]

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4 Zarnt, G. et al. Catalytic and molecular properties of the quinohemopreotein tetrahydrofurfuryl alcohol dehydrogenase from Ralstonia eutropha strain Bo. J. Bacteriol. 2001 Mar: 183 (6): 1954-60. (Abstract included in Appendix VIII of this petition.)

5 Nishiuchi, Yasuhiro. Toxicity of agrochemicals to freshwater organisms. CIII. Solvents. Suisan Zoshoko (1984), 32(2), 115-19. (Abstract included in this petition at Appendix VIII)

6 Harris, E.G; Hadaway, A.B. Solvents for Use in topical applications of insecticides. Misc. Rep. – Cent Overseas Pest Res. (U.K.) (1979), 50, 3pp. (Abstract included in this petition at Appendix VIII)

(c) environmental impacts from its use or manufacture;

THFA has a unique structure in that it contains elements of an alcohol, an ether and a cyclic molecule. In organic synthesis, THFA undergoes the reaction of a primary alcohol, while the ring exhibits characteristics of a saturated cyclic ether.[7] Commercial manufacture of THFA entails catalytic hydrogenation of furfural, the aldehyde of furan. Fufural itself is derived industrially from pentosan-containing agricultural byproducts (e.g., corncobs, oat or cottonseed hulls, and sugarcane bagasse). In actuality, then, THFA itself is ultimately derived from naturally occurring agricultural waste products.

THFA is not classified by EPA as a Hazardous Waste, and thus is not viewed as having a significant environmental impact. As an effluent in manufacturing, THFA can enter bodies of water; however, in concentrations up to 1 mg/liter, THFA does not alter the biological oxygen demand (BOD). As discussed in Item 9 (b) available data indicate it has limited environmental toxicity to aquatic organisms and insects, as well as low mammalian toxicity (discussed below at Item 9 (d)).

Hazards with THFA manufacture come from danger to handlers via explosive peroxides. THFA reacts with strong oxidants and several N-chloro- and N-bromides; these can cause fire and explosion hazards.

An increased awareness of organic solvent use in chemical processing has resulted from implementation of such diverse agreements and regulations as the Montreal Protocol, the Clean Air Act and the Pollution Prevention Act of 1990. One review discussed the search for "green" solvents to replace traditional solvents. While THFA is not specifically discussed in that review, the "green" characteristics of THF (tetrahydrofuran) derivatives are covered. An example is n-octyl tetrahydrofurfuryl ether that has been shown an effective solvent replacement for THF in the reaction series to produce the protease inhibitor Crixivan for the human immunodeficiency virus (HIV).[8]

In summary, manufacture of THFA has some hazard to workers and handlers due to fire and explosive hazards, but its environmental impacts are minimal. The EPA does not view THFA as a hazardous waste, and it is part of a group of chemistries singled out for its "green characteristics" as a solvent. These attributes make THFA an attractive solvent for continued use in organic production.

(d) effects on human health;

While extensive long-term studies have not been conducted on THFA, sufficient studies exist to clearly demonstrate that it is non-carcinogenic, non-mutagenic, and has low acute toxicity. These low toxicity characteristics demonstrate THFA to be an ideal solvent for use in organic production, which has a focus of promoting human health in food consumption and during food production. There is an exemption from tolerance (40 CFR 180.1001 (c)) with no limits on use; thus the EPA has no concerns of residues in food crops. Hazards to humans are primarily related to some explosive manufacturing potential, but to agricultural workers the only significant concern is acute eye irritation, which is mitigated by dilution in end-use pesticide products, and use of personal protective equipment (PPE) required by end-use labels. In fact, the National Library of Medicine (Hazardous Substances Data Bank, HSDB®, Appendix VI), focuses on manufacturing exposure, discounting exposure from agricultural applications, concluding that "Probable routes of human exposure are occupational through dermal contact and inhalation of vapor."

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7 *Merck Index*, 13th edition, 2001.

8 Sherman, Julie, et al, Solvent replacement for green processing. Environmental Health Perspectives 106 (Suppl): 253-271 (1998).

Supportive toxicity information from evaluation in pharmaceutical applications

THFA is not only already approved by FDA as an approved food additive (both direct and indirect), but its low toxicity has made it attractive for use and further development in the pharmaceutical industry. The use of THFA as an compounding agent in topical creams and lotions, including utilization in demonstrates it is suitable for direct human exposure. Evaluation as an organic solvent for human pharmaceutical preparations, and use in the Australian human health product *Biosal Arthritis Cream*, further demonstrates the confidence the medical community has in THFA for greater use in human drug application to alleviate human suffering and to promote health.

Direct consideration as a candidate for direct injection into humans as a drug carrier has been considered. Mottu *et al* said: "THFA is considered a "potentially useful" non-aqueous solvent for pharmaceutical formulations to dissolve water-insoluble drugs used in subcutaneous or intramuscular injection. Review of toxicity information for THFA and other similar solvents concluded that "toxicity data on intravascular organic solvents are insufficient because they concern solvents diluted with water and because of lack of comparative evaluation using the same methodologies." "[9]

Attracted by its low toxicity and superior solvent characteristics, THFA has been evaluated for other clinical applications. The possibility of THFA as a candidate to treat induced digitalis toxicity was evaluated in dogs with IV administration of 50 mg/kg THFA.[10] While it was not effective as a treatment, its use as a pharmaceutical candidate is demonstrated in such routine testing. In health and environmental screening, THFA was separately tested, along with cyclohexane, acetone, acetonitrile, ethanol and other solvents, and results indicated THFA is an acceptable solvent for mutagen testing.[11] Thus THFA is shown sufficiently compatible with biological systems that it can assist in screening and identifying toxic agents in the environment.

Acute Toxicity

As summarized in the Penn Specialty Chemicals MSDS (and consistent with other MSDS's and safety summaries in Appendices II and IV, respectively), THFA has low acute toxicity to mammals. High LD_{50} values are associated with low toxicity, and the oral LD50 in mice 2300 mg/kg and for rats is 1600 mg/kg (though the ZEBET cytotoxicity database presents this as even less toxic, at 2503 mg/kg). A complete list of acute tests presented in MSDS's are:

Rat:	Oral LD_{50} = 1600 mg/kg	Intraperitoneal LD_{50} = 400 mg/kg
Mouse:	Oral LD_{50} = 2300 mg/kg	Intravenous LD_{50} = 725 mg/kg
Guinea Pig:	Oral LD_{50} = 800 mg/kg	Dermal LD_{50} = 5000 mg/kg[12] Intraperitoneal LD_{50} = 400 mg/kg

[9] Mottu F. et al. Organic solvents for pharmaceutical parenterals and embolic liquids: a review of toxicity data. J. Pharm. Sci. Technol. 2000 Nov; 54(6): 456-69. (Abstract included Appendix VIII of this petition.)

[10] Shafer, R.B and Adicoff, A. Digitalis antagonism by a specific lactone. Current Therapeutic Research, 12, Nov. 1970, pp. 755-758. . (Abstract included in Appendix VIII of this petition.)

[11] Maron, D., Katzenellenbogen, J.; Ames. B.N. Compatibility of organic solvents with the Salmonella/ Microsome test. Mutation Research, 88 (4), 1980, pp. 343-350. (Abstract included in Appendix VIII of this petition.)

[12] Penn Specialty MSDS erroneously reports this as 5 mg/kg (no doubt a typographical error where "mg" was substituted for "gm" ; other MSDS's and sources correctly report this as 5 g/kg or 5000 mg/kg).

MSDS acute effects (e.g., Penn Specialty MSDS) are thus described as moderately irritating to eyes and skin and moderately toxic by ingestion. This is consistent with the National Library of Medicine (Hazardous Substances Data Bank, HSDB®, Appendix VI, as well as the *Merck Index* 13th edition, 2001) which describes THFA as moderately irritating to skin, mucous membranes and irritating to human eyes. It adds that no information is available about the rate in which a harmful air concentration is reached on evaporation at 20°C. Interestingly, one study evaluated 18 potential penetration enhancers and found that THFA, tested undiluted at 100%, caused no discernible change in the histological appearance of the skin over the 24 hour test period.[13]

Mutagenicity

The Penn Specialty MSDS indicates THFA is not mutagenic by the Ames test. The National Library of Medicine (Chemical Carcinogenesis Research Information System, CCRIS®, Appendix VI) confirms this by reporting six Ames tests, the results of each finding THFA negative for mutagenicity.

Subchronic Toxicity

A series of studies were conducted by Quaker Oats company in the early 1970's in support of a pesticide petition for THFA (see Item 6 above for discussion under "EPA Tolerance Assessment"). Upon acquisition by Great Lakes Corporation, a current manufacturer of THFA, various studies were summarized to EPA's Office of Toxic Substances under TSCA Section 8(e). These subchronic THFA studies contributed to a determination by EPA that an exemption for tolerance for THFA (40 CFR 180.1001 (c)) is warranted and should be established. An overview of those studies, based on review of available correspondence follows:

23 Oct 1991 Letter to US.EPA Office of Toxic Substances (Great Lakes ref RFH-91-300) regarding studies conducted by Quaker Oats subsidiary in 1970-72 to support Pesticide Petition No 2F1198 (renumbered to PP 2E1198), leading to an exemption from tolerance (40 CFR 180.1001 (c)).

- 90 day subacute [*sic*] [subchronic] oral toxicity dog study: No mortalities occurred directly related to compound administration, and there were no untoward behavioral reactions found. There were some questions raised about the appropriateness of group housing of dogs, and whether the dogs were sufficiently sexually mature for the purposes of the study.

- 90 day testicular maturation dog study: This is an apparent follow-up to the 90 day subacute [subchronic] oral toxicity study with dogs, to address deficiencies in study design. No significant differences in testes weights and testes to body weight ratios reported against the controls; even at 800 ppm normal testicular development was noted.

- 90 day subacute [subchronic] oral tox rat study: No mortalities occurred directly related to compound administration, and there were no untoward behavioral reactions found.

29 May 1992 letter to US EPA Office of Toxic Substances (Great Lakes ref JAB-108). A repeat of the 90 day subacute [subchronic] dietary rat studies was conducted under modern protocol design. No mortality or untoward behavioral reactions noted at any level. Several findings at the two high doses of 5,000 and 10,000 ppm, including depressed body weight, tissue weight differences and blood chemistry differences. At lower concentrations of 500 and 1000 ppm, there were few findings. Histological examination had not been completed at the time of this filing, and subsequent correspondence stating whether histology supported these findings as chemical related was not obtained.

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[13] Lashmar UT, et al. Topical application of penetration enhancers to the skin of nude mice: a histopathological study. J. Pharm. Pharmacol. 1989. Feb; 41(2): 118-22. (Abstract included in Appendix VIII of this petition.)

27 August 1992 Letter to US.EPA Office of Toxic Substances (Great Lakes ref JAB-92-223) regarding an oral toxicity study in rabbits. Some mortality was observed at the high dose level (1000 mg/kg/day), with necropsy revealing red areas on lungs and red foci on the stomach of those found dead (or moribund animals euthanized). Necropsy of lower three dose levels revealed no remarkable findings.

14 October 1992 letter to US EPA Office of Toxic Substances (Great Lakes ref JAB-92-294) regarding a dose range-finding developmental toxicity study in rats. No maternal mortality or abortions at any level, but early resorptions at two highest levels (500 and 1000 mg/kg/day), which also exhibited decreased food consumption and depression in weight gain. Highest dose has some clinical findings such as impaired mobility. Fetuses of all liters viable at four lower dose levels with the only significant finding being litter weights of next highest dose (100 mg/kg/day) which were lower than control.
30 August 1995 letter to US EPA Office of Toxic Substances (Great Lakes ref JAB-95-149) regarding a 90 day subchronic inhalation study with rats. Exposure levels were 50, 150 and 500 ppm. A NOEL could not be established after 13 weeks exposure.

30 August 1995 letter to US EPA Office of Toxic Substances (Great Lakes ref JAB-95-148) regarding a 90 day subchronic dermal toxicity study with rats. The NOEL was established at 100 mg/kg/day for males and 300 mg/kg/day for females.

The subchronic effects summary from the Penn Specialty MSDS and the National Library of Medicine (Hazardous Substances Data Bank, HSDB®, Appendix VI) provide an identically worded statement: "Subchronic exposures (oral, dermal and inhalation) at relatively high levels, have demonstrated developmental toxicity, reproductive toxicity, and central nervous system depression in either rats, rabbits or dogs." The Penn Specialty MSDS cautions: "Repeated or prolonged exposure to vapors may cause central nervous system depression, and decreased male fertility. Repeated or prolonged dermal contact may cause decreased male fertility, Ingestion may cause developmental effects."

Chronic Effects

No chronic effects are presented as available in the Penn Speciality MSDS or any other source located.

Carcinogenicity

Great Lakes Chemical Corporation MSDS indicates that THFA is not listed as a carcinogen by NTP or IARC. This is supported by the Environmental Defense Scorecard (Appendix IV) which indicates THFA is not a recognized carcinogen, either by inhalation or ingestion.

(e) effects on soil organisms, crops, or livestock.

Available environmental information on THFA demonstrate it is environmentally-friendly and readily biodegrades, and the use rate of the agricultural products it is utilized in is very low per acre. There is thus little opportunity for THFA to accumulate in the environment and threaten biological systems. Studies on aquatic organisms (i.e., tadpoles) and insects (such as houseflies and stableflies) show THFA to be of low toxicity to wildlife, and there are no data showing adverse effects on soil organisms. Similarly, no evidence of phytoxicity to crops has been shown, and the referenced agricultural formulation is less phytotoxic than many other formulation at similar use rates; furthermore, there are no livestock concerns as evidenced by the exemption from tolerance (40 CFR 180.1001 (c)) and data supporting low mammalian toxicity.

10. Safety information about the substance including a Material Safety Data Sheet (MSDS) and a substance report from the National Institute of Environmental Health Studies.

MSDS: Example MSDS documents attached in Appendix II, specifically those from:

- Great Lakes Chemical Corporation

- Sigma-Aldrich
- Penn Specialty Chemicals, Inc.

NIEHS: No substance report from National Institute for Environmental Health Studies was available.

OTHER SAFETY INFORMATION:

Presented in Appendix IV are the following safety summaries:

- EPA Envirofact Warehouse Chemical References
- Environmental Defense Scorecard
- National Institute of Standards and Technology Websheet
- NIOSH International Chemical Safety Card
- IPCS INCHEM Chemical Safety Card
- ChemFinder Safety Summary
- ChemFate Physical Properties Summary
- TSCA Chemical Substances Inventory Extract (Cornell U.)
- ZEBET Database: Registry of Cytotoxicity

Sources Consulted with No Information Found on THFA

- National Pesticide Information Retrieval System (NPIRS)
- EXTOXNET
- EPA IRIS Database

11. Research information about the substance that includes comprehensive substance research reviews and research bibliographies, including reviews and bibliographies which present contrasting positions to those presented by the petitioner in supporting the substance's inclusion on or removal from the National List.

There are considerable numbers of acute safety profiles available on THFA (see Appendix IV), but broader technical information is scattered across a number of sources, with no comprehensive reviews readily available. In Appendix VI are presented results of various electronic searches of the scientific literature:

- National Library of Medicine, Hazardous Substances Data Bank (HSDB®) – Toxicity Profile from multiple literature sources.
- National Library of Medicine, Chemical Carcinogenesis Research Information System (CCRIS®) – Carcinogenicity and mutagenicity Profile from multiple literature sources.
- TOXLINE Search – Citations of 29 toxicology references.
- STN Database search and FOIA Follow-up (by Bergeson and Campbell, PC.) – 68 citations presented (some redundant to TOXLINE and HSDB databases).
- RETR Search conducted by NERAC.COM – Toxicity keyword focus, 10 citations.
- RETR Search conducted by NERAC.COM – FDA keyword focus, 1 citation.
- RETR Search conducted by NERAC.COM – Pesticide keyword focus, 3 citations.

Relevant studies in the above listings were obtained where the available abstracts were not sufficiently informative. These studies are summarized in Item 9 (b) above.

Review Articles: Discussed above in Item 9 (c) is one review article located which concerns environmentally-friendly solvents. Another review article, discussed below in Item 12, compares THFA to other known solvents, and endorses THFA as an underutilized, low toxicity agrochemical solvent. A third review article

reviewed toxicity data for organic non-aqueous solvents which could be vehicles for subcutaneous and intramuscular injection of pharmaceuticals (discussed above at Item 9(b)). These articles are:

- Sherman, Julie, et al, Solvent replacement for green processing. Environmental Health Perspectives 106 (Suppl): 253-271 (1998).
- McKillip, Doyel *et al.* Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents. Adjuvants Agrichem. 1992, pp. 225-34. (Included in Appendix VII of this petition.)
- Mottu F. et al. Organic solvents for pharmaceutical parenterals and embolic liquids: a review of toxicity data. J. Pharm. Sci. Technol. 2000 Nov; 54(6): 456-69. (Abstract included Appendix VIII of this petition.)

12. A ``Petition Justification Statement'' which provides justification for one of the following actions requested in the petition: [[Page 43261]]

When petitioning for the inclusion of a synthetic substance on the National List, the petition should state why the synthetic substance is necessary for the production or handling of an organic product.

THFA has unique qualities as a solvent allowing production of [ ] chemicals for organic use by growers in formulated products. The solubility profile of THFA allows ready dissolution of various percent range limonoids. AMVAC Chemical has a patent pending for this unique use of THFA. CBI-DELETED

McKillip *et al* endorse wider use of THFA in agrochemical applications as follows:

> Tetrahydrofurfuryl alc. (THFA) as an agrochem. adjuvant has seen limited com[mercial] applications. THFA's underexploited status is believed due to lack of publicly available data regarding its characteristics. Inherently low toxicity, low volatility, biodegradability, and high solvency in both org. and aq. systems make THFA an attractive candidate for use with agrochems.... The data presented should provide formulators with another option when selecting formulation chem. for current or exptl. active ingredients. [14]

The advantages of employing this THFA in agricultural products are THFA is: CBI-DELETED

a. A unique solvent for [ ] pesticides, and our company has a patent pending for this use; additionally this is part of a group of "green solvents" assessed by EPA;
b. Has low toxicity to non-target organisms with a very low use rate (0.0005 oz THFA per ft^2);
c. Rapidly biodegradable and non-persistent in the environment;
d. Currently is established by FDA (on EAFUS list) as a food additive;
e. Exempt from EPA tolerance;
f. A benign material that is non-mutagenic, non-teratogenic and with no long-term chronic or carcinogenic effects,
g. A product with origins as a plant-derived material,
h. Requested by OMRI for continued use in organic production, and
i. A product where risk assessments which have completed to date by various governmental Agencies have not identified concerns with continued use of THFA in organic production.

The petition should also describe the nonsynthetic substances or alternative cultural methods that could be used in place of the petitioned synthetic substance.

There are no nonsynthetic solvents that may be used to formulate [ ] products of adequate dispersion characteristics, stability and performance. Among the available synthetic solvents, THFA has superior environmental and toxicity characteristics as compared to cyclohexanone and xylene (both on EPA Inerts List 2, Potentially Toxic Inerts/High Priority for Testing), and is in the same toxicity range as other CBI-DELETED

[14] McKillip, Doyel *et al.* Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents. Adjuvants Agrichem. 1992, pp. 225-34. (Included in Appendix VII of this petition.)

alcohols (such as methanol, and ethanol (already on EPA List 4B)). A particularly illustrative example is the comparison of cyclohexanol. Although both THFA and cyclohexanol are currently on EPA Inerts List 3, THFA acute oral toxicity levels are over 3 times less than cyclohexanol.[3] This is supportive of EPA moving THFA to Inerts List 4B, and for NOSB including THFA on the National List.

Additionally, the petition should summarize the beneficial effects to the environment, human health, or farm ecosystem from use of the synthetic substance that support the use of it instead of the use of a nonsynthetic substance or alternative cultural methods.

Continued access to THFA as an organic solvent will promote availability of [ ] products. Maintaining such [ ] pesticide products in the markeplace is important for organic production. [CBI-DELETED

,] it is relatively harmless to spiders, other insects such a pollinating bees, ladybugs, earthworms and other wildlife. It is non-phytotoxic, of low toxicity to mammals, has low soil mobility and does not accumulate in the environment. In organic production, formulated [ ] are effective at low rates, provide a worker-friendly 12 hour re-entry interval (REI) and are compatible with IPM and resistance management programs. The active [ ], with which THFA is used as a solvent, is also exempt from tolerance by] with a [ ] day pre-harvest interval.

Respectfully submitted by,
AMVAC CHEMICAL CORPORATION
4695 MacArthur Court, Suite 1250
Newport Beach, CA 92660

LIST OF APPENDICES

1. THFA Exemption from Tolerance (40 CFR 180.1001 (c)
   FDA EAFUS Food Additives Database (21 CFR 172, 175 and 176)
2. MSDS Sheets
3. General Information on Production, Nomenclature and Product Uses
4. EPA and Other Third Party Hazards and Risk Summaries
5. NPIRS Study Listing
6. Bibliographic Listings of Scientific Literature (with limited abstracts)
7. Journal article: Doyel, K.J. et al. Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents. Adjuvants Agrichem. 1992, pp. 225-34
8. Toxicology Study Abstracts via NCBI and STNEasy

APPENDIX I

THFA Exemption from Tolerance (40 CFR 180.1001(c))

FDA EAFUS Food Additives Database (21 CFR 172, 175, and 176

§ 180.572 Bifenazate; tolerance for residues.

(a) *General.* [Reserved]

(b) *Section 18 emergency exemptions.* Time limited tolerances are established for combined residues of bifenazate, (hydrazine carboxylic acid, 2-(4-methoxy-[1,1'-biphenyl]-3-yl-, 1-methylethyl ester) and diazenecarboxylic acid, 2-(4-methoxy-[1,1'-biphenyl]-3-yl-, 1-methylethyl ester in connection with use of the pesticide under section 18 emergency exemptions granted by the EPA. The tolerances will expire and are revoked on the dates specified in the following table.

Commodity	Parts per million	Expiration/ Revocation Date
Tomato	0.70	6/30/03

(c) *Tolerances with regional registrations.* [Reserved]

(d) *Indirect or inadvertent residues.* [Reserved]

[66 FR 34569, June 29, 2001]

Subpart D—Exemptions From Tolerances

§ 180.1001 Exemptions from the requirement of a tolerance.

(a) An exemption from a tolerance shall be granted when it appears that the total quantity of the pesticide chemical in or on all raw agricultural commodities for which it is useful under conditions of use currently prevailing or proposed will involve no hazard to the public health.

(b) When applied to growing crops, in accordance with good agricultural practice, the following pesticide chemicals are exempt from the requirement of a tolerance:

(1) [Reserved]

(2) *N*-Octylbicyclo(2,2,1)-5-heptene-2,3-dicarboximide.

(3) Petroleum oils.

(4) Piperonyl butoxide.

(5) [Reserved]

(6) Pyrethrum and pyrethrins.

(7) Rotenone or derris or cube roots.

(8) Sabadilla.

These pesticides are not exempted from the requirement of a tolerance when applied to a crop at the time of or after harvest.

(c) Residues of the following materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest:

Inert ingredients	Limits	Uses
Acetic acid		Catalyst
Acetic anhydride		Solvent, cosolvent
Acetone		Do.
Acrylamide potassium acrylate—acrylic acid copolymer, cross-linked (CAS Reg. No. 31212–13–2), minimum number average molecular weight (in atomic mass units (amu)) 1,000,000.		Carrier
Acrylic acid—stearyl methacrylate copolymer (CAS Reg. No. 27758–15–6), minimum number average molecular weight (in amu) 2,500.		Emulsifier, suspending agent, or rheology modifier
Acrylic acid, styrene, α-methyl styrene Copolymer, ammonium salt (CAS Reg. No. 89678–90–0), minimum number average molecular weight (in amu) 1250.		Encapsulating agent, dispensers, resins, fibers and beads
Acrylic acid terpolymer, partial sodium salt (CAS Reg. No. 151006–66–5), minimum number average molecular weight (in amu) 2,400.		Dispersant
Alkanoic and alkenoic acids, mono- and diesters of α-hydro-ω-hydroxypoly (oxyethylene) with molecular weight (in amu) range of 200 to 6,000.		Emulsifiers
Alkyl (C_6-C_{24}) benzenesulfonic acid and its ammonium, calcium, magnesium, potassium, sodium, and zinc salts.		Surfactants, related adjuvants of surfactants
α-Alkyl (C_9-C_{18}-ω-hydroxypoly(oxyethylene) with poly(oxyethylene) content of 2-30 moles.		Solvent, cosolvent, surfactant, and related adjuvants of surfactants

Inert ingredients	Limits	Uses
α-(*p*-Alkylphenyl)-ω-hydroxypoly(oxyethylene) produced by the condensation of 1 mole of alkylphenol (alkyl is a mixture of propylene tetramer and pentamer isomers and averages C_{13}) with 8 moles of ethylene oxide.		Surfactants, related adjuvants of surfactants
α-alkyl (C_{12}-C_{15})-ω-hydroxypoly (oxypropylene)poly (oxyethylene)copolymers (where the poly(oxypropylene) content is 3-60 moles and the poly(oxyethylene) content is 5-80 moles), the resulting ethoxylated propoxylated (C_{12}-C_{15}) alcohols having a minimum molecular weight (in amu) of 1,500, CAS Reg. No. 68551–13–3.	Not to exceed 20% of pesticide formulations	Surfactant
α-Alkyl (C_6-C_{14})-ω-hydroxypoly(oxypropylene) block copolymer with polyoxyethylene; polyoxypropylene content is 1-3 moles; polyoxyethylene content is 4-12 moles; average molecular weight (in amu) is approximately 635.		Do.
α-alkyl (C_{12}-C_{15})-ω-hydroxypoly (oxypropylene) poly (oxyethylene) copolymers (where the poly (oxypropylene) content is 3–60 moles and the poly (oxyethylene) content is 5–80 moles).	Not more than 20% of pesticide formulations	Surfactant
Alkyl (C_8-C_{18}) sulfate and its ammonium, calcium, isopropylamine, magnesium, potassium, sodium, and zinc salts.		Surfactants.
Almond shells		Solid diluent and carrier
Aluminum hydroxide		Diluent, carrier
Aluminum oxide		Diluent
Aluminum stearate		Surfactant
Ammonium bicarbonate		Surfactant, suspending agent, dispersing agent
Ammonium carbamate		Synergist in aluminum phosphide formulations
Ammonium chloride		Intensifier when used with ammonium nitrate as a dessicant or defoliant. Fire suppressant in aluminum phosphide and magnesium phosphide formulations
Ammonium hydroxide		Solvent, cosolvent, neutralizer, solubilizing agent
Ammonium stearate		Surfactant
Ammonium sulfate		Solid diluent, carrier
Ammonium thiosulfate		Intensifier when used with ammonium nitrate as desiccant or defoliant
Amyl acetate		Solvent, cosolvent, attractant
Animal glue		Surfactant, adhesive
Apple pomace		Solid diluent, carrier
Ascorbic acid (CAS Reg. No. 50–81–7)		Stabilizer, preservative
Ascorbyl palmitate		Preservative
Attapulgite-type clay		Solid diluent, carrier, thickener
Bacillus thuringiensis fermentation solids and/or solubles.		Diluent, carrier
Beeswax		Coating agent
Bentonite		Solid diluent, carrier
Benzoic acid		Preservative for formulation
Butane		Propellant
n-Butanol (CAS Reg. No. 71–36–3)		Solvent, cosolvent
Butene, homopolymer minimum number average molecular weight (in amu) 1,330 (CAS Reg. No. 9003–29–6).		Sticker, surfactant and related adjuvant
Butyl acrylate-vinyl acetate-acrylic acid copolymer (CAS Reg. No. 65405–40–5), minimum number average molecular weight 18,000 daltons.		Surfactants, related adjuvants of surfactants
Butylated hydroxyanisole		Antioxidant
Butylated hydroxytoluene		Do.
α-Butyl-ω-hydroxypoly(oxypropylene) block polymer with poly(oxyethylene); molecular weight (in amu) 2,400-3,500.		Surfactants, related adjuvants of surfactants

Inert ingredients	Limits	Uses
Styrene, copolymers with acrylic acid and/or methacrylic acid, with none and/or one or more of the following monomers: acrylamidopropyl methyl sulfonic acid, methallyl sulfonic acid, 3-sulfopropyl acrylate, 3-sulfopropyl methacrylate, hydroxypropyl methacrylate, hydroxypropyl acrylate, hydroxyethyl methacrylate, and/or hydroxy-ethyl acrylate; and its sodium, potassium, ammonium, monoethanolamine, and triethanolamine salts; the resulting polymer having a minimum number average molecular weight (in amu) of 1,200.	Notto exceed 25% informulated product	Carriers, adhesives, binders, suspending and dispersing agents, related adjuvants in pesticide formulations
Sucrose		Solid diluent carrier, safener
Sucrose octaacetate		Adhesive
Sulfuric acid (CAS Reg. No. 7664-93-9) that meets the Food Chemicals Codex specifications.	0.1% of pesticide formulation.	pH control agent
Sulfurous acid		Preservative
Synthetic paraffin and its succinic derivatives conforming to 21 CFR 172.275.		Carrier, binder, and carrying agent
Synthetic petroleum wax, conforming to 21 CFR 172.888.		Binder, carrier, and coating agent
Talc		Solid diluent, carriers
Tall oil; fatty acids not less than 58%, rosin acids not more than 44%, unsaponifiables not more than 8%.		Surfactants, related adjuvants of surfactants
Tartrazine		Dye
1,1,1,2-Tetrafluoroethane, (CAS Reg. No. 811-97-2).		Aerosol propellant
Tetrahydrofurfuryl alcohol		Solvent cosolvent
α-[*p*-(1,1,3,3-Tetramethylbutyl)phenyl]-ω-hydroxypoly(oxyethylene) produced by the condensation of 1 mole of *p*-(1,1,3,3-tetramethylbutyl)phenol with a range of 1-14 or 30-70 moles of ethylene oxide: if a blend of products is used, the average range number of moles of ethylene oxide reacted to produce any product that is a component of the blend shall be in the range of 1-14 or 30-70.		Surfactants, related adjuvants of surfactants
α-[*p*-(1,1,3,3-Tetramethylbutyl) phenyl]-ω-hydroxypoly(oxyethylene) produced by the condensation of 1 mole of *p*-(1,1,3,3-tetramethylbutyl) phenol with an average of 4-14 or 30-70 moles of ethylene oxide; if a blend of products is used, the average number of moles of ethylene oxide reacted to produce any product that is a component of the blend shall be in the range of 4-14 or 30-70.		Do.
2,4,7,9-Tetramethyl-5-decyn-4, 7-diol	Not more than 2.5% of pesticide formulation.	Surfactants, related adjuvants of surfactants
Tetrasodium pyrophosphate		Anticaking agent, conditioning agent
Tricalcium phosphate		Surfactant, suspending agent, dispersing agent, anticaking agent, conditioning agent
1,1,1-Trichloroethane		Solvent, cosolvent
Trichlorofluoromethane		Propellant
Tridecylpoly(oxyethylene) acetate, sodium salt; where the ethylene oxide content averages 6-7 moles.		Surfactants, related adjuvants of surfactants
Trisodium phosphate		Surfactant, emulsifier, wetting agent
Urea		Stabilizer, inhibitor
Vermiculite		Solid diluent, carrier.
Vinyl alcohol-vinyl acetate copolymer, benzaldehyde-o-sodium sulfonate condensate, minimum number average molecular weight (in amu) 20, 000.		Water soluble resin
Vinyl pyrrolidone-acrylic acid copolymer (CAS Reg. No. 28062-44-4), minimum number average molecular weight (in amu) 6,000.		Adhesive, dispersion stabilizer and coating for sustained release granules
Vinyl pyrrolidone-dimethylaminoethylmethacrylate copolymer (CAS Reg. No. 30581-59-0), minimum number average molecular weight (in amu) 20,000.		Leaching inhibitor, binder for water-dispersible aggregates, sticker and suspension stabilizer

Inert ingredients	Limits	Uses
Walnut shells		Do.
Wheat bran		Do.
Wintergreen oil		Attractant
Wood flour	Derived from wood free of chemical preservatives.	Solid diluent and carrier
Xanthan gum		Thickener
Xanthan gum-modified, produced by the reaction of xanthan gum and glyoxal (maximum 0.3% by weight).	Not more than 0.5% of pesticide formulation.	Surfactant
Xylene meeting the specifications listed in 21 CFR 172.884(b)(4).	In pesticide formulations for grain storage only.	Solvent, cosolvent
Zeolite (hydrated alkali aluminum silicate)		Solid diluent, carrier
Zinc oxide		Coating agent
Zinc sulfate (basic and monohydrate)		Do.
Zinc sulfate (basic and monohydrate)		Solid diluent, carrier

(d) The following materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only:

Inert ingredients	Limits	Uses
Acetic acid ethenyl ester, polymer with ethenol and (α)-2-propenyl-(ω)-hydroxypoly (oxy-1,2-ethanediyl) (CAS Reg. No.137091-12-4); minimum number average molecular weight 15,000.		Component of water-soluble film
Acetonitrile	Not more than 0.5% of pesticide formulation.	Solvent for blended emulsifiers in all pesticides used before crop emerges from soil and in herbicides before or after crop emerges
Acetophenone		Attractant
Acrylamide—acrylic acid resins		Thickeners
Acrylamide—sodium acrylate resins		Do.
Acrylic acid, polymerized, and its ethyl and methyl esters.		Surfactants, related adjuvants of surfactants
Acrylic acid—sodium acrylate—sodium-2-methylpropanesulfonate copolymer (minimum average molecular weight (in amu) 4,500); CAS No. 97953-25-8.		Dispersing agent
Acrylonitrile—styrene—hydroxypropyl methacrylate copolymer; minimum number average molecular weight (in amu) 447,000.		Pigment carrier
Adenosine (CAS Reg. No. 58-61-7)	Maximum of 0.5% of formulation.	Synergist
Alder bark		Seed germination stimulator
α-Alkyl (C_{12}-C_{18})-ω-hydroxypoly(oxyethylene) copolymers with poly(oxypropylene); polyoxyethylene content averages 3-12 moles and polyoxypropylene content 2-9 moles.		Surfactants, related adjuvants of surfactants
α-Alkyl (C_{10}-C_{16})-ω-hydroxypoly(oxyethylene) mixture of dihydrogen phosphate and monohydrogen phosphate esters and the corresponding ammonium, calcium, magnesium, monoethanolamine, potassium, sodium, and zinc salts of the phosphate esters; the poly(oxyethylene) content averages 3-20 moles.		Surfactants, related adjuvants of surfactants
α-Alkyl (C_{12-C16})-ω-hydroxypoly(oxyethylene) sulfosuccinate, isopropylamine and *N*-hydroxyethyl isopropylamine salts of; the poly(oxyethylene) content averages 3-12 moles.	Not more than 0.2% in the final solution.	Emulsifiers in pesticide concentrates applied with liquid fertilizer solutions before crop emerges from soil or not later than 4 weeks after planting
α-Alkyl(C_{10}-C_{12})-ω-hydroxypoly(oxyethylene) poly(oxypropylene) copolymer; poly(oxyethylene) content is 11-15 moles; poly(oxypropene) content is 1-3 moles.		Surfactants, related adjuvants of surfactants.

U.S. Food and Drug Administration
Center for Food Safety & Applied Nutrition
Office of Food Additive Safety

EAFUS: A Food Additive Database

This is an informational database maintained by the U.S. Food and Drug Administration (FDA) Center for Food Safety and Applied Nutrition (CFSAN) under an ongoing program known as the Priority-based Assessment of Food Additives (PAFA). It contains administrative, chemical and toxicological information on over 2000 substances directly added to food, including substances regulated by the U.S. Food and Drug Administration (FDA) as direct, "secondary" direct, and color additives, and Generally Recognized As Safe (GRAS) and prior-sanctioned substances. In addition, the database contains only administrative and chemical information on less than 1000 such substances. The more than 3000 total substances together comprise an inventory often referred to as *"Everything" Added to Food in the United States* (EAFUS).

This list of substances contains ingredients added directly to food that FDA has either approved as food additives or listed or affirmed as GRAS. Nevertheless, it contains only a partial list of all food ingredients that may in fact be lawfully added to food, because under federal law some ingredients may be added to food under a GRAS determination made independently from the FDA. The list contains many, but not all, of the substances subject to independent GRAS determinations. For information about the GRAS notification program please consult the Inventory of GRAS Notifications.

The list below is an alphabetical inventory representing only five of 196 fields in FDA/CFSAN's PAFA database. Definitions of the labels that are found in the inventory are:

Label	Definition	
DOCTYPE	An indicator of the status of the toxicology information available for the substance (administrative and chemical information is available on all substances):	
	ASP	Fully up-to-date toxicology information has been sought.
	EAT	There is reported use of the substance, but it has not yet been assigned for toxicology literature search.
	NEW	There is reported use of the substance, and an initial toxicology literature search is in progress.
	NIL	Although listed as a added to food, there is no current reported use of the substance, and, therefore, although toxicology information may be available in PAFA, it is not being updated.
	NUL	There is no reported use of the substance and there is no toxicology information available in PAFA.
	BAN	The substance was formerly approved as a food additive but is now banned; there may be some toxicology data available.
DOCNUM	PAFA database number of the *Food Additive Safety Profile* volume containing the primary source information concerning the substance.	
MAINTERM	The name of the substance as recognized by CFSAN.	
CAS RN OR OTHER CODE	Chemical Abstract Service (CAS) Registry Number for the substance or a numerical code assigned by CFSAN to those substances that do not have a CAS Registry Number (888nnnnnn or 977nnnnnn series).	
REGNUM	Regulation numbers in Title 21 of the U.S. Code of Federal Regulations where the substance appears.	

To access the specific regulations listed below, type in the title number, **21**, and then the section and part numbers, *e.g.* **184** and **1330** at the Government Printing Office web site.

To search this list, use your browser's "find" feature. In most web browsers look under the **Edit** menu at the top of your browser window and click on **Find** (or use **CTRL-F**) to bring up the browser's "find" window. Type in the phrase you wish to search on, and your browser window should move to the next occurrence of that phrase on this web page.

2001-JUN-08

EVERYTHING ADDED TO FOOD IN THE UNITED STATES

DOC TYPE	DOC NUM	MAINTERM	CAS RN OR OTHER CODE	REGNUM
ASP	1464	TETRAHYDROFURFURYL ALCOHOL	000097-99-4	172.515 175.105 176.180 176.210

Common name	Scientific name	Limitations
Olibanum	*Boswellia carteri* Birdw. and other *Boswellia* spp.	
Opopanax (bisabolmyrrh)	*Opopanax chironium* Koch (true opopanax) of *Commiphora erythraea* Engl. var. *Llabrescens.*	
Orris root	*Iris germanica* L. (including its variety *florentina* Dykes) and *I. pallida* Lam.	
Pansy	*Viola tricolor* L.	In alcoholic beverages only.
Passion flower	*Passiflora incarnata* L.	
Patchouly	*Pogostemon cablin* Benth. and *P. heyneanus* Benth.	
Peach leaves	*Prunus persica* (L.) Batsch	In alcoholic beverages only; not to exceed 25 p.p.m. prussic acid in the flavor.
Pennyroyal, American	*Hedeoma pulegioides* (L.) Pers.	
Pennyroyal, European	*Mentha pulegium* L.	
Pine, dwarf, needles and twigs	*Pinus mugo* Turra var. *pumilio* (Haenke) Zenari.	
Pine, Scotch, needles and twigs	*Pinus sylvestris* L.	
Pine, white, bark	*Pinus strobus* L.	In alcoholic beverages only.
Pine, white oil	*Pinus palustris* Mill., and other *Pinus* spp.	
Poplar buds	*Populus balsamifera* L. (*P. tacamahacca* Mill.), *P. candicans* Ait., or *P. nigra* L.	Do.
Quassia	*Picrasma excelsa* (Sw.) Planch, or *Quassia amara* L.	
Quebracho bark	*Aspidosperma quebracho-blanco* Schlecht, or (*Quebrachia lorentzii* (Griseb)).	*Schinopsis lorentzii* (Griseb.) Engl.
Quillaia (soapbark)	*Quillaja saponaria* Mol.	
Red saunders (red sandalwood)	*Pterocarpus san alinus* L.	In alcoholic beverages only.
Rhatany root	*Krameria triandra* Ruiz et Pav. or *K. argentea* Mart.	
Rhubarb, garden root	*Rheum rhaponticum* L.	Do.
Rhubarb root	*Rheum officinale* Baill., *R. palmatum* L., or other spp. (excepting *R. rhaponticum* L.) or hybrids of *Rheum* grown in China.	
Roselle	*Hibiscus sabdariffa* L.	Do.
Rosin (colophony)	*Pinus palustris* Mill., and other *Pinus* spp.	Do.
St. Johnswort leaves, flowers, and caulis	*Hypericum perforatum* L.	Hypericin-free alcohol distillate form only; in alcoholic beverages only.
Sandalwood, white (yellow, or East Indian)	*Santalum album* L.	
Sandarac	*Tetraclinis articulata* (Vahl.), Mast	In alcoholic beverages only.
Sarsaparilla	*Smilax aristolochiaefolia* Mill., (Mexican sarsaparilla), *S. regelii* Killip et Morton (Honduras sarsaparilla), *S. febrifuga* Kunth (Ecuadorean sarsaparilla), or undetermined *Smilax* spp. (Ecuadorean or Central American sarsaparilla).	
Sassafras leaves	*Sassafras albidum* (Nutt.) Nees	Safrole free.
Senna, Alexandria	*Cassia acutifolia* Delile	
Serpentaria (Virginia snakeroot)	*Aristolochia serpentaria* L.	In alcoholic beverages only.
Simaruba bark	*Simaruba amara* Aubl.	Do.
Snakeroot, Canadian (wild ginger)	*Asarum canadense* L.	
Spruce needles and twigs	*Picea glauca* (Moench) Voss or *P. mariana* (Mill.) BSP.	
Storax (styrax)	*Liquidambar orientalis* Mill. or *L. styraciflua* L.	
Tagetes (marigold)	*Tagetes patula* L., *T. erecta* L., or *T. minuta* L. (*T. glandulifera* Schrank).	As oil only.
Tansy	*Tanacetum vulgare* L.	In alcoholic beverages only; finished alcoholic beverage thujone free.[1]
Thistle, blessed (holy thistle)	*Onicus benedictus* L.	In alcoholic beverages only.
Thymus capitatus (Spanish "origanum").	*Thymus capitatus* Hoffmg. et Link.	
Tolu	*Myroxylon balsamum* (L.) Harms	
Turpentine	*Pinus palustris* Mill. and other *Pinus* spp. which yield terpene oils exclusively.	
Valerian rhizome and roots	*Valeriana officinalis* L.	
Veronica	*Veronica officinalis* L.	Do.
Vervain, European	*Verbena officinalis* L.	Do.
Vetiver	*Vetiveria zizanioides* Stapf	Do.
Violet, Swiss	*Viola calcarata* L.	
Walnut husks (hulls), leaves, and green nuts.	*Juglans nigra* L. or *J. regia* L.	
Woodruff, sweet	*Asperula odorata* L.	In alcoholic beverages only.
Yarrow	*Achillea millefolium* L.	In beverages only; finished beverage thujone free.[1]
Yerba santa	*Eriodictyon californicum* (Hook. et Arn.) Torr.	
Yucca, Joshua-tree	*Yucca brevifolia* Engelm.	
Yucca, Mohave	*Yucca schidigera* Roezl ex Ortgies (*Y. mohavensis* Sarg.).	

[1] As determined by using the method (or, in other than alcoholic beverages, a suitable adaptation thereof) in section 9.129 of the "Official Methods of Analysis of the Association of Official Analytical Chemists," 13th Ed. (1980), which is incorporated by reference. Copies may be obtained from the Association of Official Analytical Chemists, 2200 Wilson Blvd., Suite 400, Arlington VA 22201-3301, or may be examined at the Office of the Federal Register, 1100 L St. NW., Washington, DC 20408

[42 FR 14491, Mar. 15, 1977, as amended at 43 FR 14644, Apr. 7, 1978; 49 FR 10104, Mar. 19, 1984; 54 FR 24897, June 12, 1989]

§ 172.515 Synthetic flavoring substances and adjuvants.

Synthetic flavoring substances and adjuvants may be safely used in food in accordance with the following conditions.

(a) They are used in the minimum quantity required to produce their intended effect, and otherwise in accordance with all the principles of good manufacturing practice.

(b) They consist of one or more of the following, used alone or in combination with flavoring substances and adjuvants generally recognized as safe in food, prior-sanctioned for such use, or regulated by an appropriate section in this part.

Acetal; acetaldehyde diethyl acetal.
Acetaldehyde phenethyl propyl acetal.
Acetanisole; 4'-methoxyacetophenone.
Acetophenone; methyl phenyl ketone.
Allyl anthranilate.
Allyl butyrate.
Allyl cinnamate.
Allyl cyclohexaneacetate.
Allyl cyclohexanebutyrate.
Allyl cyclohexanehexanoate.
Allyl cyclohexanepropionate.
Allyl cyclohexanevalerate.
Allyl disulfide.
Allyl 2-ethylbutyrate.
Allyl hexanoate; allyl caproate.
Allyl α-ionone; 1-(2,6,6-trimethyl-2-cyclohexene-1-yl)-1,6-heptadiene-3-one.
Allyl isothiocyanate; mustard oil.
Allyl isovalerate.
Allyl mercaptan; 2-propene-1-thiol.
Allyl nonanoate.
Allyl octanoate.
Allyl phenoxyacetate.
Allyl phenylacetate.
Allyl propionate.
Allyl sorbate; allyl 2,4-hexadienoate.
Allyl sulfide.
Allyl tiglate; allyl *trans*-2-methyl-2-butenoate.
Allyl 10-undecenoate.
Ammonium isovalerate.
Ammonium sulfide.
Amyl alcohol; pentyl alcohol.
Amyl butyrate.
α-Amylcinnamaldehyde.
α-Amylcinnamaldehyde dimethyl acetal.
α-Amylcinnamyl acetate.
α-Amylcinnamyl alcohol.
α-Amylcinnamyl formate.
α-Amylcinnamyl isovalerate.
Amyl formate.
Amyl heptanoate.
Amyl hexanoate.
Amyl octanoate.
Anisole; methoxybenzene.
Anisyl acetate.
Anisyl alcohol; *p*-methoxybenzyl alcohol.
Anisyl butyrate
Anisyl formate.
Anisyl phenylacetate.
Anisyl propionate.
Beechwood creosote.
Benzaldehyde dimethyl acetal.
Benzaldehyde glyceryl acetal; 2-phenyl-*m*-dioxan-5-ol.
Benzaldehyde propylene glycol acetal; 4-methyl-2-phenyl-*m*-dioxolane.
Benzenethiol; thiophenol.
Benzoin; 2-hydroxy-2-phenylacetophenone.
Benzophenone; diphenylketone.
Benzyl acetate.
Benzyl acetoacetate.
Benzyl alcohol.
Benzyl benzoate.
Benzyl butyl ether.
Benzyl butyrate.
Benzyl cinnamate.
Benzyl 2,3-dimethylcrotonate; benzyl methyl tiglate.
Benzyl disulfide; dibenzyl disulfide.
Benzyl ethyl ether.
Benzyl formate.
3-Benzyl-4-heptanone; benzyl dipropyl ketone.
Benzyl isobutyrate.
Benzyl isovalerate.
Benzyl mercaptan; α-toluenethiol.

Methyl octanoate.
Methyl 2-octynoate; methyl heptine carbonate.
4-Methyl-2,3-pentanedione; acetyl isobutyryl.
4-Methyl-2-pentanone; methyl isobutyl ketone.
β-Methylphenethyl alcohol; hydratropyl alcohol.
Methyl phenylacetate.
3-Methyl-4-phenyl-3-butene-2-one.
2-Methyl-4-phenyl-2-butyl acetate; dimethylphenylethyl carbinyl acetate.
2-Methyl-4-phenyl-2-butyl isobutyrate; dimethylphenyl ethylcarbinyl isobutyrate.
3-Methyl-2-phenylbutyraldehyde; α-isopropyl phenylacetaldehyde.
Methyl 4-phenylbutyrate.
4-Methyl-1-phenyl-2-pentanone; benzyl isobutyl ketone.
Methyl 3-phenylpropionate; methyl hydrocinnamate.
Methyl propionate.
3-Methyl-5-propyl-2-cyclohexen-1-one.
Methyl sulfide.
3-Methylthiopropionaldehyde; methional.
2-Methyl-3-tolylpropionaldehyde, mixed *o*-, *m*-, *p*-.
2-Methylundecanal; methyl nonyl acetaldehyde.
Methyl 9-undecenoate.
Methyl 2-undecynoate; methyl decyne carbonate.
Methyl valerate.
2-Methylvaleric acid.
Myrcene; 7-methyl-3-methylene-1,6-octadiene.
Myristaldehyde; tetradecanal.
d-Neomenthol; 2-isopropyl-5-methylcyclohexanol.
Nerol; *cis*-3,7-dimethyl-2,6-octadien-1-ol.
Nerolidol; 3,7,11-trimethyl-1,6,10-dodecatrien-3-ol.
Neryl acetate.
Neryl butyrate.
Neryl formate.
Neryl isobutyrate.
Neryl isovalerate.
Neryl propionate.
2,6-Nonadien-1-ol.
γ-Nonalactone; 4-hydroxynonanoic acid, γ-lactone; aldehyde C-18.
Nonanal; pelargonic aldehyde.
1,3-Nonanediol acetate, mixed esters.
Nonanoic acid; pelargonic acid.
2-Nonanone; methylheptyl ketone.
3-Nonanon-1-yl acetate; 1-hydroxy-3-nonanone acetate.
Nonyl acetate.
Nonyl alcohol; 1-nonanol.
Nonyl octanoate.
Nonyl isovalerate.
Nootkatone; 5,6-dimethyl-8-isopropenyl-bicyclo[4,4,0]-dec-1-en-3-one.
Ocimene; *trans*-β-ocimene; 3,7-dimethyl-1,3,6-octatriene.
γ-Octalactone; 4-hydroxyoctanoic acid, γ-lactone.
Octanal; caprylaldehyde.
Octanal dimethyl acetal.
1-Octanol; octyl alcohol.
2-Octanol.
3-Octanol.
2-Octanone; methyl hexyl ketone.
3-Octanone; ethyl amyl ketone.
3-Octanon-1-ol.
1-Octen-3-ol; amyl vinyl carbinol.
1-Octen-3-yl acetate.
Octyl acetate.
3-Octyl acetate.
Octyl butyrate.
Octyl formate.
Octyl heptanoate.
Octyl isobutyrate.
Octyl isovalerate.
Octyl octanoate.
Octyl phenylacetate.
Octyl propionate.
ω-Pentadecalactone; 15-hydroxypentadecanoic acid, ω-lactone; pentadecanolide; angelica lactone.
2,3-Pentanedione; acetyl propionyl.
2-Pentanone; methyl propyl ketone.
4-Pentenoic acid.
1-Penten-3-ol.
Perillaldehyde; 4-isopropenyl-1-cyclohexene-1-carboxaldehyde;*p*-mentha-1,8-dien-7-al.
Perillyl acetate; *p*-mentha-1,8-dien-7-yl acetate.
α-Phellandrene; *p*-mentha-1,5-diene.
Phenethyl acetate.
Phenethyl alcohol; β-phenylethyl alcohol.
Phenethyl anthranilate.
Phenethyl benzoate.
Phenethyl butyrate.
Phenethyl cinnamate.
Phenethyl formate.
Phenethyl isobutyrate.
Phenethyl isovalerate.
Phenethyl 2-methylbutyrate.
Phenethyl phenylacetate.
Phenethyl propionate.
Phenethyl salicylate.
Phenethyl senecioate; phenethyl 3,3-dimethylacrylate.
Phenethyl tiglate.
Phenoxyacetic acid.
2-Phenoxyethyl isobutyrate.
Phenylacetaldehyde; α-toluic aldehyde.
Phenylacetaldehyde 2,3-butylene glycol acetal.
Phenylacetaldehyde dimethyl acetal.
Phenylacetaldehyde glyceryl acetal.
Phenylacetic acid; α-toluic acid.
4-Phenyl-2-butanol; phenylethyl methyl carbinol.
4-Phenyl-3-buten-2-ol; methyl styryl carbinol.
4-Phenyl-3-buten-2-one.
4-Phenyl-2-butyl acetate; phenylethyl methyl carbinyl acetate.

1-Phenyl-3-methyl-3-pentanol; phenylethyl methyl ethyl carbinol.
1-Phenyl-1-propanol; phenylethyl carbinol.
3-Phenyl-1-propanol; hydrocinnamyl alcohol.
2-Phenylpropionaldehyde; hydratropaldehyde.
3-Phenylpropionaldehyde; hydrocinnamaldehyde.
2-Phenylpropionalde-hyde dimethyl acetal; hydratropic aldehyde dimethyl acetal.
3-Phenylpropionic acid; hydrocinnamic acid.
3-Phenylpropyl acetate.
2-Phenylpropyl butyrate.
3-Phenylpropyl cinnamate.
3-Phenylpropyl formate.
3-Phenylpropyl hexanoate.
2-Phenylpropyl isobutyrate.
3-Phenylpropyl isobutyrate.
3-Phenylpropyl isovalerate.
3-Phenylpropyl propionate.
2-(3-Phenylpropyl)-tetrahydrofuran.
α-Pinene; 2-pinene.
β-Pinene; 2(10)-pinene.
Pine tar oil.
Pinocarveol; 2(10)-pinen-3-ol.
Piperidine.
Piperine.
d-Piperitone; *p*-menth-1-en-3-one.
Piperitenone; *p*-mentha-1,4(8)-dien-3-one.
Piperitenone oxide; 1,2-epoxy-*p*-menth-4-(8)-en-3-one.
Piperonyl acetate; heliotropyl acetate.
Piperonyl isobutyrate.
Polylimonene.
Polysorbate 20; polyoxyethylene (20) sorbitan monolaurate.
Polysorbate 60; polyoxyethylene (20) sorbitan monostereate.
Polysorbate 80; polyoxyethylene (20) sorbitan monooleate.
Potassium acetate.
Propenylguaethol; 6-ethoxy-*m*-anol.
Propionaldehyde.
Propyl acetate.
Propyl alcohol; 1-propanol.
p-Propyl anisole; dihydroanethole.
Propyl benzoate.
Propyl butyrate.
Propyl cinnamate.
Propyl disulfide.
Propyl formate.
Propyl 2-furanacrylate.
Propyl heptanoate.
Propyl hexanoate.
Propyl *p*-hydroxybenzoate; propylparaben.
3-Propylidenephthalide.
Propyl isobutyrate.
Propyl isovalerate.
Propyl mercaptan.
α-Propylphenethyl alcohol.
Propyl phenylacetate.
Propyl propionate.
Pulegone; *p*-menth-4(8)-en-3-one.
Pyridine.
Pyroligneous acid extract.
Pyruvaldehyde.
Pyruvic acid.
Rhodinol; 3,7-dimethyl-7-octen-1-ol; *l*-citronellol.
Rhodinyl acetate.
Rhodinyl butyrate.
Rhodinyl formate.
Rhodinyl isobutyrate.
Rhodinyl isovalerate.
Rhodinyl phenylacetate.
Rhodinyl propionate.
Rum ether; ethyl oxyhydrate.
Salicylaldehyde.
Santalol, α and β.
Santalyl acetate.
Santalyl phenylacetate.
Skatole.
Sorbitan monostearate.
Styrene.
Sucrose octaacetate.
α-Terpinene.
γ-Terpinene.
α-Terpineol; *p*-menth-1-en-8-ol.
β-Terpineol.
Terpinolene; *p*-menth-1,4(8)-diene.
Terpinyl acetate.
Terpinyl anthranilate.
Terpinyl butyrate.
Terpinyl cinnamate.
Terpinyl formate.
Terpinyl isobutyrate.
Terpinyl isovalerate.
Terpinyl propionate.
Tetrahydrofurfuryl acetate.
Tetrahydrofurfuryl alcohol.
Tetrahydrofurfuryl butyrate.
Tetrahydrofurfuryl propionate.
Tetrahydro-pseudo-ionone; 6,10-dimethyl-9-undecen-2-one.
Tetrahydrolinalool; 3,7-dimethyloctan-3-ol.
Tetramethyl ethylcyclohexenone; mixture of 5-ethyl-2,3,4,5-tetramethyl-2-cyclohexen-1-one and 5-ethyl-3,4,5,6-tetramethyl-2-cyclohexen-1-one.
2-Thienyl mercaptan; 2-thienylthiol.
Thymol.
Tolualdehyde glyceryl acetal, mixed *o*, *m*, *p*.
Tolualdehydes, mixed *o*, *m*, *p*.
p-Tolylacetaldehyde.
o-Tolyl acetate; *o*-cresyl acetate.
p-Tolyl acetate; *p*-cresyl acetate.
4-(*p*-Tolyl)-2-butanone; *p*-methylbenzylacetone.
p-Tolyl isobutyrate.
p-Tolyl laurate.
p-Tolyl phenylacetate.
2-(*p*-Tolyl)-propionaldehyde; *p*-methylhydratropic aldehyde.
Tributyl acetylcitrate.
2-Tridecenal.
2,3-Undecadione; acetyl nonyryl.
γ-Undecalactone; 4-hydroxyundecanoic acid γ-lactone; peach aldehyde; aldehyde C-14.
Undecenal.
2-Undecanone; methyl nonyl ketone.
9-Undecenal; undecenoic aldehyde.
10-Undecenal.

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(b) It is used at levels not to exceed 0.2 percent of the reaction mixture to catalyze the directed esterification.

(c) The esterification reaction is quenched with steam and water and the catalyst is removed with the aqueous phase. Final traces of catalyst are removed by washing batches of the product three times with an aqueous solution of 0.5 percent sodium bicarbonate.

(d) No residual catalyst may remain in the product at a detection limit of 0.2 part per million fluoride as determined by the method described in "Official Methods of Analysis of the Association of Official Analytical Chemists," sections 25.049-25.055, 13th Ed. (1980), which is incorporated by reference. Copies may be obtained from the Association of Official Analytical Chemists, 2200 Wilson Blvd., Suite 400, Arlington, VA 22201-3301, or may be examined at the Office of the Federal Register, 1100 L St. NW., Washington, DC 20408.

[43 FR 54237, Nov. 11, 1978, as amended at 49 FR 10106, Mar. 19, 1984; 54 FR 24897, June 12, 1989]

PART 174—INDIRECT FOOD ADDITIVES: GENERAL

AUTHORITY: Secs. 201, 402, 409, 701 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 321, 342, 348, 371).

§ 174.5 General provisions applicable to indirect food additives.

(a) Regulations prescribing conditions under which food additive substances may be safely used predicate usage under conditions of good manufacturing practice. For the purpose of this part and parts 175, 176, and 177 of this chapter, good manufacturing practice shall be defined to include the following restrictions:

(1) The quantity of any food additive substance that may be added to food as a result of use in articles that contact food shall not exceed, where no limits are specified, that which results from use of the substance in an amount not more than reasonably required to accomplish the intended physical or technical effect in the food-contact article; shall not exceed any prescribed limitations; and shall not be intended to accomplish any physical or technical effect in the food itself, except as such may be permitted by regulations in parts 170 through 189 of this chapter.

(2) Any substance used as a component of articles that contact food shall be of a purity suitable for its intended use.

(b) The existence in the subchapter B of a regulation prescribing safe conditions for the use of a substance as an article or component of articles that contact food shall not be construed to relieve such use of the substance or article from compliance with any other provision of the Federal Food, Drug, and Cosmetic Act. For example, if a regulated food-packaging material were found on appropriate test to impart odor or taste to a specific food product such as to render it unfit within the meaning of section 402(a)(3) of the Act, the regulation would not be construed to relieve such use from compliance with section 402(a)(3).

(c) The existence in this subchapter B of a regulation prescribing safe conditions for the use of a substance as an article or component of articles that contact food shall not be construed as implying that such substance may be safely used as a direct additive in food.

(d) Substances that under conditions of good manufacturing practice may be safely used as components of articles that contact food include the following, subject to any prescribed limitations:

(1) Substances generally recognized as safe in or on food.

(2) Substances generally recognized as safe for their intended use in food packaging.

(3) Substances used in accordance with a prior sanction or approval.

(4) Substances permitted for use by regulations in this part and parts 175, 176, 177, 178 and § 179.45 of this chapter.

[42 FR 14534, Mar. 15, 1977]

PART 175—INDIRECT FOOD ADDITIVES: ADHESIVES AND COMPONENTS OF COATINGS

Subpart A—[Reserved]

Subpart B—Substances for Use Only as Components of Adhesives

Sec.
175.105 Adhesives.
175.125 Pressure-sensitive adhesives.

Subpart C—Substances for Use as Components of Coatings

175.210 Acrylate ester copolymer coatings.
175.230 Hot-melt strippable food coatings.
175.250 Paraffin (synthetic).
175.260 Partial phosphoric acid esters of polyester resins.
175.270 Poly(vinyl fluoride) resins.
175.300 Resinous and polymeric coatings.
175.320 Resinous and polymeric coatings for polyolefin films.
175.350 Vinyl acetate/crotonic acid copolymer.
175.360 Vinylidene chloride copolymer coatings for nylon film.
175.365 Vinylidene chloride copolymer coatings for polycarbonate film.
175.380 Xylene-formaldehyde resins condensed with 4,4'-isopropylidenediphenol-epichlorohydrin epoxy resins.
175.390 Zinc-silicon dioxide matrix coatings.

AUTHORITY: Secs. 201, 402, 409, 706 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 321, 342, 348, 376).

SOURCE: 42 FR 14534, Mar. 15, 1977, unless otherwise noted.

Subpart A—[Reserved]

Subpart B—Substances for Use Only as Components of Adhesives

§ 175.105 Adhesives.

(a) Adhesives may be safely used as components of articles intended for use in packaging, transporting, or holding food in accordance with the following prescribed conditions:

(1) The adhesive is prepared from one or more of the optional substances named in paragraph (c) of this section, subject to any prescribed limitations.

(2) The adhesive is either separated from the food by a functional barrier or used subject to the following additional limitations:

(i) *In dry foods.* The quantity of adhesive that contacts packaged dry food shall not exceed the limits of good manufacturing practice.

(ii) *In fatty and aqueous foods.* (*a*) The quantity of adhesive that contacts packaged fatty and aqueous foods shall not exceed the trace amount at seams and at the edge exposure between packaging laminates that may occur within the limits of good manufacturing practice.

(*b*) Under normal conditions of use the packaging seams or laminates will remain firmly bonded without visible separation.

(b) To assure safe usage of adhesives, the label of the finished adhesive container shall bear the statement "food-packaging adhesive".

(c) Subject to any limitation prescribed in this section and in any other regulation promulgated under section 409 of the Act which prescribes safe conditions of use for substances that may be employed as constituents of adhesives, the optional substances used in the formulation of adhesives may include the following:

(1) Substances generally recognized as safe for use in food or food packaging.

(2) Substances permitted for use in adhesives by prior sanction or approval and employed under the specific conditions of use prescribed by such sanction or approval.

(3) Flavoring substances permitted for use in food by regulations in this part, provided that such flavoring substances are volatilized from the adhesives during the packaging fabrication process.

(4) Color additives approved for use in food.

(5) Substances permitted for use in adhesives by other regulations in this subchapter and substances named in this subparagraph: *Provided, however,* That any substance named in this paragraph and covered by a specific regulation in this subchapter, must meet any specifications in such regulation.

Substances	Limitations
Starch, reacted with a urea-formaldehyde resin	
Starch, reacted with formaldehyde	
Stearamide (stearic acid amide)	
Stearic acid	
Stearic acid-chromic chloride complex	
Stearyl-cetyl alcohol, technical grade, approximately 65 percent-80 percent stearyl and 20 percent-35 percent cetyl.	
Strontium salicylate	
Styrenated phenol	
Styrene block polymers with 1,3-butadiene	
Styrene-maleic anhydride copolymer, ammonium or potassium salt	
Styrene-maleic anhydride copolymer (partially methylated) sodium salt	
Styrene-methacrylic acid copolymer, potassium salt	
Sucrose acetate isobutyrate	
Sucrose benzoate	
Sucrose octaacetate	
2-sulfoethyl methacrylate (CAS Registry No. 10595-80-9)	For use at levels not to exceed 2 percent by weight of the dry adhesive.
α-Sulfo-omega-(dodecyloxy)poly (oxyethylene), ammonium salt	
Sulfonated octadecylene (sodium form)	
Sulfosuccinic acid 4-ester with polyethylene glycol dodecyl ether disodium salt (alcohol moiety produced by condensation of 1 mole of *n*-dodecyl alcohol and an average of 5-6 moles of ethylene oxide, Chemical Abstracts Service Registry No. 039354-45-5).	
Sulfosuccinic acid 4-ester with polyethylene glycol nonylphenyl ether, disodium salt (alcohol moiety produced by condensation of 1 mole of nonylphenol and an average of 9-10 moles of ethylene oxide) (CAS Reg. No. 9040-38-4).	
Sulfur	
Synthetic primary linear aliphatic alcohols whose weight average molecular weight is greater than 400 (CAS Reg. No. 71750-71-5).	
Synthetic wax polymer as described in § 176.170(a)(5) of this chapter	
Tall oil	
Tall oil fatty acids, linoleic and oleic	
Tall oil fatty acid methyl ester	
Tall oil, methyl ester	
Tall oil pitch	
Tall oil soaps	
Tallow alcohol (hydrogenated)	
Tallow amine, secondary (hexadecyl, octadecyl), of hard tallow	
Tallow, blown (oxidized)	
Tallow, propylene glycol ester	
Terpene resins (α-and β-pinene) homopolymers, copolymers, and condensates with phenol, formaldehyde, coumarone, and/or indene.	
Terphenyl	
Terphenyl, hydrogenated	
Terpineol	
Tetraethylene pentamine	
Tetraethylthiuram disulfide	
Tetrahydrofuran	
Tetrahydrofurfuryl alcohol	
Tetra-isopropyl titanate	
Tetrakis[methylene (3,5-di-*tert*-butyl-4-hydroxy-hydro-cinnamate)] methane.	
A[*p*-(1,1,3,3-Tetramethylbutyl) phenyl]-*omega*-hydroxypoly-(oxyethylene) produced by the condensation of 1 mole of *p*-(1,1,3,3-tetramethylbutyl) phenol with an average of 1-40 moles of ethylene oxide.	
A-[*p*-(1,1,3,3-Tetramethylbutyl) phenyl]-*omega*-hydroxypoly(oxyethylene) mixture of dihydrogen phosphate and monohydrogen phosphate esters and their sodium, potassium, and ammonium salts having a poly(oxyethylene) content averaging 6-9 or 40 moles.	
Tetramethyl decanediol	
Tetramethyl decynediol	
Tetramethyl decynediol plus 1-30 moles of ethylene oxide	
Tetramethylthiuram monosulfide	
Tetrasodium *N*-(1,2-dicarboxyethyl)-*N*-octadecylsulfosuccinamate	
4,4'-Thiobis-6-*tert*-butyl-*m*-cresol	
Thiodiethylene-bis(3,5-di-*tert*-butyl-4-hydroxyhydrocinnamate)	
2,2'-(2,5-Thiophenediyl) bis[5-*tert*-butylbenzoxazole]	
Thiram	
Thymol	For use as preservative only.

Substances	Limitations
Titanium dioxide	
Titanium dioxide-barium sulfate	
Titanium dioxide-calcium sulfate	
Titanium dioxide-magnesium silicate	
Toluene	
Toluene 2,4-diisocyanate	
Toluene 2,6-diisocyanate	
o- and *p*-Toluene ethyl sulfonamide	
o- and *p*-Toluene sulfonamide	
p-Toluene sulfonic acid	
p- (*p*'-Toluene-sulfonylamide)-diphenylamide	
Triazine-formaldehyde resins as described in § 175.300(b)(3)(xiii)	
Tributoxyethyl phosphate	
Tributylcitrate	
Tri-*tert*-butyl-*p*-phenyl phenol	For use as preservative only.
Tributyl phosphate	
Tributyltin chloride complex of ethylene oxide condensate of dehydroabietylamine.	For use as preservative only.
Tri-*n*-butyltin acetate	For use as preservative only.
Tri-*n*-butyltin neodecanoate	Do.
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethylene	
Tri-β-chloroethylphosphate	
Tridecyl alcohol	
Triethanolamine	
3-(Triethoxysilyl) propylamine	
Triethylene glycol	
Triethylene glycol dibenzoate	
Triethylene glycol di(2-ethylhexoate)	
Triethylene glycol polyester of benzoic acid and phthalic acid	
Triethylhexyl phosphate	
Triethylphosphate	
2,4,5-Trihydroxy butyrophenone	
Triisopropanolamine	
Trimethylol propane	
2,2,4-Trimethylpentanediol-1,3-diisobutyrate	
Trimeric aromatic amine resin from diphenylamine and acetone of molecular weight approximately 500.	
Tri(nonylphenyl) phosphite-formaldehyde resins	As identified in § 177.2600(c)(4)(iii) of this chapter. For use only as a stabilizer.
Triphenylphosphate	
Tripropylene glycol monomethyl ether	
1,3,5-Tris (3,5-di-*tert*-butyl-4-hydroxy-benzyl)-triazine-2,4,6 (1H,3H,5H)-trione.	
Tris (*p*-tertiary butyl phenyl) phosphate	
Tris(2-methyl-4-hydroxy-5-*tert*-butyl-phenyl)butane	
Trisodium *N*-hydroxyethylethylenediaminetriacetate (CAS Reg. No. 139-89-9).	
Turpentine	
Urea-formaldehyde resins as described in § 175.300(b)(3)(xii)	
Vegetable oil, sulfonated or sulfated, potassium salt	
Vinyl acetate-maleic anhydride copolymer, sodium salt	
Waxes, petroleum	
Wax, petroleum, chlorinated (40% to 70% chlorine)	
Waxes, synthetic paraffin (Fischer-Tropsch process)	
3-(2-Xenolyl)-1,2-epoxypropane	
Xylene	
Xylene (or toluene) alkylated with dicyclopentadiene	
Zein	
Zinc acetate	
Zinc ammonium chloride	
Zinc dibenzyl dithiocarbamate	
Zinc dibutyldithiocarbamate	
Zinc diethyldithiocarbamate	
Zinc di(2-ethylhexoate)	
Zinc formaldehyde sulfoxylate	
Zinc naphthenate and dehydroabietylamine mixture	
Zinc nitrate	
Zinc orthophosphate	
Zinc resinate	
Zinc sulfide	
Zineb (zinc ethylenebis-dithiocarbamate)	

substituted for e in the equations in paragraph (d)(5)(i) (a) and (b) of this section. (Note: In the case of chloroform-soluble extracts which contain high melting waxes (melting point greater than 170° F), it may be necessary to dilute the heptane solution further so that a 50-milliliter aliquot will contain only 0.1–0.2 gram of the chloroform-soluble extract residue.)

(e) Acrylonitrile copolymers identified in this section shall comply with the provisions of § 180.22 of this chapter, except where the copolymers are restricted to use in contact with food only of the type identified in paragraph (c), Table 1 under Category VIII.

[42 FR 14554, Mar. 15, 1977]

EDITORIAL NOTE: FOR FEDERAL REGISTER citations affecting § 176.170, see the List of CFR Sections Affected in the Finding Aids section of this volume.

§ 176.180 Components of paper and paperboard in contact with dry food.

The substances listed in this section may be safely used as components of the uncoated or coated food-contact surface of paper and paperboard intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding dry food of the type identified in § 176.170(c), Table 1, under Type VIII, subject to the provisions of this section.

(a) The substances are used in amounts not to exceed that required to accomplish their intended physical or technical effect, and are so used as to accomplish no effect in food other than that ordinarily accomplished by packaging.

(b) The substances permitted to be used include the following:

(1) Substances that by § 176.170 and other applicable regulations in parts 170 through 189 of this chapter may be safely used as components of the uncoated or coated food-contact surface of paper and paperboard, subject to the provisions of such regulation.

(2) Substances identified in the following list:

List of substances	Limitations
(2-Alkenyl) succinic anhydrides in which the alkenyl groups are derived from olefins which contain not less than 78 percent C_{20} and higher groups (CAS Reg. No. 70983-55-0).	
4-[2-[2-(2-Alkoxy(C_{12}–C_{14}) ethoxy) ethoxy]ethyl]disodium sulfosuccinate.	For use as a polymerization emulsifier and latex emulsion stabilizer at levels not to exceed 5 percent by weight of total emulsion solids.
Aluminum and calcium salts of FD & C dyes on a substrate of alumina.	Colorant.
Ammonium nitrate	
Amylose	
Barium metaborate	For use as preservative in coatings and sizings.
1,2-Benzisothiazolin-3-one (CAS Registry No. 2634-33-5)	For use only as a preservative in paper coating compositions and limited to use at a level not to exceed 0.02 mg/in² (0.0031 mg/cm²) of finished paper and paperboard.
N,N'-Bis(hydroxyethyl)lauramide	
Bis(trichloromethyl) sulfone C.A. Registry No. 3064-70-8	For use only as a preservative in coatings.
Borax	For use as preservative in coatings.
Boric acid	Do.
sec-Butyl alcohol	
Butyl benzyl phthalate	
Candelilla wax	
Carbon tetrachloride	
Castor oil, polyoxyethylated (42 moles ethylene oxide)	
Cationic soy protein hydrolyzed (hydrolyzed soy protein isolate modified by treatment with 3-chloro-2-hydroxypropyl-trimethylammonium chloride).	For use only as a coating adhesive, pigment structuring agent, and fiber retention aid.
Cationic soy protein (soy protein isolate modified by treatment with 3-chloro-2-hydroxypropyltrimethyl-ammonium chloride).	For use only as a coating adhesive, pigment structuring agent, and fiber retention aid.
Chloral hydrate	Polymerization reaction-control agent.
N-Cyclohexyl-*p*-toluene sulfonamide	
2,5-Di-*tert*-butyl hydroquinone	
Diethanolamine	
Diethylene glycol dibenzoate (CAS Reg. No. 120-55-8)	For use only as a plasticizer in polymeric substances.
Diethylene glycol monobutyl ether	
Diethylene glycol monoethyl ether	

List of substances	Limitations
Diethylenetriamine	
N,N-Diisopropanolamide of tallow fatty acids	
N-[(dimethylamino)methyl]acrylamide polymer with acrylamide and styrene.	
N,N-Dioleoylethylenediamine, *N,N*-dilinoeoyl-ethylenediamine, and N-oleoyl-N-linoleoyl-ethylenediamine mixture produced when tall oil fatty acids are made to react with ethylenediamine such that the finished mixture has a melting point of 212°-228° F, as determined by ASTM method D127-60, and an acid value of 10 maximum. ASTM Method D127-60 "Standard Method of Test for Melting Point of Petrolatum and Microcrystalline Wax" (Revised 1960) is incorporated by reference. Copies are available from University Microfilms International, 300 N. Zeeb Rd., Ann Arbor, MI 48106, or available for inspection at the Office of the Federal Register, 1100 L St. NW., Washington, DC 20408.	
Diphenylamine	
Dipropylene glycol dibenzoate (CAS Reg. No. 27138-31-4)	For use only as plasticizer in polymeric substances.
Disodium *N*-octadecylsulfosuccinamate	
tert-Dodecyl thioether of polyethylene glycol	
Erucamide (erucylamide)	
Ethanedial, polymer with tetrahydro-4-hydroxy-5-methyl-2(1*H*)pyrimidinone, propoxylated.	
Ethylene oxide	Fumigant in sizing.
Ethylene oxide adduct of mono-(2-ethylhexyl) *o*-phosphate	
Fatty acid (C_{16}–C_{18}) diethanolamide	
Fish oil fatty acids, hydrogenated, potassium salt	
Formaldehyde	
Glycaryl monocaprate	
Glyceryl tribenzoate (CAS Reg. No. 614-33-5)	For use only as a plasticizer in polymeric coatings.
Glyoxal	
Glyoxal-urea-formaldehyde condensate (CAS Reg. No. 27013-01-0) formed by reaction in the molar ratio of approximately 47:33:15, respectively. The reaction product has a number average molecular weight of 276±14 as determined by a suitable method.	For use as an insolubilizer for starch in coatings.
Glyoxal-urea polymer (CAS Reg. No. 53037-34-6)	For use as an insolubilizer for starch
Hexamethylenetetramine	Polymerization crosslinking agent for protein, including casein. As neutralizing agent with myristochromic chloride complex and stearato-chromic chloride complex.
Hexylene glycol (2-methyl-2,4-pentanediol)	
Hydroabietyl alcohol	
5-Hydroxymethoxymethyl-1-aza-3,7-dioxabicyclo[3.3.0] octane, 5-hydroxymethyl-1-aza-3,7-dioxabicyclo[3.3.0]octane, and 5-hydroxypoly-[methyleneoxy]methyl-1-aza-3,7-dioxabicyclo[3.3.0] octane mixture.	For use only as an antibacterial preservative.
Isopropanolamine hydrochloride	
Isopropyl *m*- and *p*-cresol (thymol derived)	
Itaconic acid	
Maleic anhydride-diisobutylene copolymer, ammonium or sodium salt.	
Melamine-formaldehyde modified with:	Basic polymer.
Alcohols (ethyl, butyl, isobutyl, propyl, or isopropyl).	
Diethylenetriamine.	
Imino-bis-butylamine.	
Imino-bis-ethyleneimine.	
Imino-bis-propylamine.	
Polyamines made by reacting ethylenediamine or trimethylenediamine with dichloroethane or dichloropropane.	
Sulfanilic acid.	
Tetraethylenepentamine.	
Triethylenetetramine.	
Methyl alcohol	
Methyl esters of mono-, di-, and tripropylene glycol	
Methyl napthalene sulfonic acid-formaldehyde condensate, sodium salt.	
Methylated poly(*N*-1,2-dihydroxyethylene-1,3-imidazolidin-2-one).	For use only only as an in solubilizer for starch

List of substances	Limitations
Modified polyacrylamide resulting from an epichlorohydrin addition to a condensate of formaldehyde-dicyandiamide-diethylene triamine and which product is then reacted with polyacrylamide and urea to produce a resin having a nitrogen content of 5.6 to 6.3 percent and having a minimum viscosity in 56 percent-by-weight aqueous solution of 200 centipoises at 25° C, as determined by LVT-series Brookfield viscometer using a No. 4 spindle at 60 r.p.m. (or equivalent method).	For use only as a dry strength and pigment retention aid agent employed prior to the sheetforming operation in the manufacture of paper and paperboard and used at a level not to exceed 1 percent by weight of dry fibers.
Mono- and di(2-alkenyl)succinyl esters of polyethylene glycol containing not less than 90 percent of the diester product and in which the alkenyl groups are derived from olefins that contain not less than 95 percent of C_{18}-C_{21} groups.	For use only as an emulsifier.
Monoglyceride citrate	
Myristo chromic chloride complex	
Napthalene sulfonic acid-formaldehyde condensate, sodium salt.	
Nickel	
β-Nitrostyrene	Basic polymer.
α-*cis*-9-Octadecenyl-*omega*-hydroxypoly (oxyethylene); the octadecenyl group is derived from oleyl alcohol and the poly(oxyethylene) content averages not less than 20 moles.	
α-(*p*-Nonylphenyl)-*omega*-hydroxypoly (oxyethylene) sulfate, ammonium salt; the nonyl group is a propylene trimer isomer and the poly (oxyethylene) content averages 9 or 30 moles.	
Oleic acid reacted with *N*-alkyl-(C_{16}-C_{18}) trimethylenediamine	
Oxidized soy isolate having 50 to 70 percent of its cystine residues oxidized to cysteic acid.	For use as a binder adhesive component of coatings.
Petroleum alicyclic hydrocarbon resins, or the hydrogenated product thereof, complying with the identity prescribed in § 176.170(b)(2).	For use as modifiers at levels up to 30 weight-percent of the solids content of wax-polymer blend coatings.
Petroleum hydrocarbon resins (produced by the catalytic polymerization and subsequent hydrogenation of styrene, vinyltoluene, and indene types from distillates of cracked petroleum stocks).	
Petroleum hydrocarbons, light and odorless	
Petroleum sulfonates	
o-Phthalic acid modified hydrolyzed soy protein isolate	
Pine oil	
Poly(2-aminoethyl acrylate nitrate-*co*-2-hydroxypropyl acrylate) complying with the identity described in § 176.170(a).	
Polyamide-epichloro hydrin modified resins resulting from the reaction of the initial caprolactam-itaconic acid product with diethylenetriamine and then condensing this prepolymer with epichlorohydrin to form a cationic resin having a nitrogen content of 11-15 percent and chlorine level of 20-23 percent on a dry basis.	
Polybutene, hydrogenated; complying with the identity prescribed under § 178.3740(b) of this chapter.	
Poly [2-(diethylamino) ethyl methacrylate] phosphate	
Polyethylene glycol (200) dilaurate	
Polymers: Homopolymers and copolymers of the following monomers:	Basic polymer.
Acrylamide.	
Acrylic acid and its methyl, ethyl, butyl, propyl, or octyl esters.	
Acrylonitrile.	
Butadiene.	
Crotonic acid.	
Cyclol acrylate.	
Decyl acrylate.	
Diallyl fumarate.	
Diallyl maleate.	
Diallyl phthalate.	
Dibutyl fumarate.	
Dibutyl itaconate.	
Dibutyl maleate.	
Di(2-ethylhexyl) maleate.	
Dioctyl fumarate.	
Dioctyl maleate.	
Divinylbenzene.	
Ethylene.	

List of substances	Limitations
2-Ethylhexyl acrylate.	
Fumaric acid.	
Glycidyl methacrylate.	
2-Hydroxyethyl acrylate.	
N-(Hydroxymethyl) acrylamide.	
Isobutyl acrylate.	
Isobutylene.	
Isoprene.	
Itaconic acid.	
Maleic anhydride and its methyl or butyl esters.	
Methacrylic acid and its methyl, ethyl, butyl, or propyl esters.	
Methylstyrene.	
Mono(2-ethylhexyl) maleate.	
Monoethyl maleate.	
5-Norbornene-2,3-dicarboxylic acid, mono-*n*-butyl ester.	
Styrene.	
Vinyl acetate.	
Vinyl butyrate.	
Vinyl chloride.	
Vinyl crotonate.	
Vinyl hexoate.	
Vinylidene chloride.	
Vinyl pelargonate.	
Vinyl propionate.	
Vinyl pyrrolidone.	
Vinyl stearate.	
Vinyl sulfonic acid.	
Polymer prepared from urea, ethanedial, formaldehyde, and propionaldehyde (CAS Reg. No. 106589-82-8).	For use only as a starch and protein reactant in paper and paperboard coatings.
Polyoxyethylene (minimum 12 moles) ester of tall oil (30%-40% rosin acids).	
Polyoxypropylene-polyoxyethylene glycol (minimum molecular weight 1,900).	
Polyvinyl alcohol	
Potassium titanate fibers produced by calcining titanium dioxide, potassium chloride, and potassium carbonate, such that the finished crystalline fibers have a nominal diameter of 0.20-0.25 micron, a length-to-diameter ratio of approximately 25:1 or greater, and consist principally of $K_2Ti_6O_{13}$ and $K_2Ti_4O_{13}$.	
Sodium diisobutylphenoxy diethoxyethyl sulfonate	
Sodium diisobutylphenoxy monoethoxy ethylsulfonate	
Sodium *n*-dodecylpolyethoxy (50 moles) sulfate	
Sodium isododecylphenoxypolyethoxy (40 moles) sulfate	
Sodium *N*-methyl-*N*-oleyl taurate	
Sodium methyl siliconate	
Sodium nitrite	
Sodium polyacrylate	
Sodium bis-tridecylsulfosuccinate	
Sodium xylene sulfonate	
Stearato chromic chloride complex	
Styrene-allyl alcohol copolymers	
Styrene-methacrylic acid copolymer, potassium salt	
Tetraethylenepentamine	Polymerization cross-linking agent.
α-[*p*-(1,1,3,3-Tetramethylbutyl)phenyl]-*omega*-hydroxypoly(oxyethylene) mixture of dihydrogen phosphate and monohydrogen phosphate esters and their sodium, potassium, and ammonium salts having a poly(oxyethylene) content averaging 6-9 or 40 moles.	
α-[*p*-(1,1,3,3-Tetramethylbutyl)phenyl or *p*-nonylphenyl]-*omega*-hydroxypoly (oxyethylene) where nonyl group is a propylene trimer isomer.	
Tetrasodium *N*-(1,2-dicarboxyethyl)-*N*-octadecyl sulfosuccinamate.	
Toluene	
Triethanolamine	
Triethylenetetramine	Polymerization cross-linking agent.
Triethylenetetramine monoacetate, partially stearoylated	
Urea-formaldehyde chemically modified with:	
Alcohol (methyl, ethyl, butyl, isobutyl, propyl, or isopropyl).	
Aminomethylsulfonic acid.	
Diaminobutane.	

THFA not listed

List of substances	Limitations
Sodium trichlorophenate	
Sperm oil, sulfated, ammonium, potassium, or sodium salt	
Stearyl alcohol	
Tall oil fatty acids	
Tallow fatty acids, hydrogenated or sulfated	
Tallow, sulfated, ammonium, potassium, or sodium salt	
Triethanolamine	
Triisopropanolamine	
Waxes, petroleum	Do

(e) The defoaming agents are used as follows:

(1) The quantity of defoaming agent or agents used shall not exceed the amount reasonably required to accomplish the intended effect, which is to prevent or control the formation of foam.

(2) The defoaming agents are used in the preparation and application of coatings for paper and paperboard.

§ 176.210 Defoaming agents used in the manufacture of paper and paperboard.

Defoaming agents may be safely used in the manufacture of paper and paperboard intended for use in packaging, transporting, or holding food in accordance with the following prescribed conditions:

(a) The defoaming agents are prepared from one or more of the substances named in paragraph (d) of this section, subject to any prescribed limitations.

(b) The defoaming agents are used to prevent or control the formation of foam during the manufacture of paper and paperboard prior to and during the sheet-forming process.

(c) The quantity of defoaming agent or agents added during the manufacturing process shall not exceed the amount necessary to accomplish the intended technical effect.

(d) Substances permitted to be used in the formulation of defoaming agents include substances subject to prior sanctions or approval for such use and employed subject to the conditions of such sanctions or approvals, substances generally recognized as safe for use in food, substances generally recognized as safe for use in paper and paperboard, and substances listed in this paragraph, subject to the limitations, if any, prescribed.

(1) Fatty triglycerides, and the fatty acids, alcohols, and dimers derived therefrom:

Beef tallow.
Castor oil.
Coconut oil.
Corn oil.
Cottonseed oil.
Fish oil.
Lard oil.
Linseed oil.
Mustardseed oil.
Palm oil.
Peanut oil.
Rapeseed oil.
Ricebran oil.
Soybean oil.
Sperm oil.
Tall oil.

(2) Fatty triglycerides, and marine oils, and the fatty acids and alcohols derived therefrom (paragraph (d)(1) of this section) reacted with one or more of the following, with or without dehydration, to form chemicals of the category indicated in parentheses:

Aluminum hydroxide (soaps).
Ammonia (amides).
Butanol (esters).
Butoxy-polyoxypropylene, molecular weight 1,000-2,500 (esters).
Butylene glycol (esters).
Calcium hydroxide (soaps).
Diethanolamine (amides).
Diethylene glycol (esters).
Ethylene glycol (esters).
Ethylene oxide (esters and ethers).
Glycerin (mono- and diglycerides).
Hydrogen (hydrogenated compounds).
Hydrogen (amines).
Isobutanol (esters).
Isopropanol (esters).
Magnesium hydroxide (soaps).
Methanol (esters).
Morpholine (soaps).
Oxygen (air-blown oils).
Pentaerythritol (esters).
Polyoxyethylene, molecular weights 200, 300, 400, 600, 700, 1,000, 1,540, 1,580, 1,760, 4,600 (esters).

Polyoxypropylene, molecular weight 200-2,000 (esters).
Potassium hydroxide (soaps).
Propanol (esters).
Propylene glycol (esters).
Propylene oxide (esters).
Sodium hydroxide (soaps).
Sorbitol (esters).
Sulfuric acid (sulfated and sulfonated compounds).
Triethanolamine (amides and soaps).
Triisopropanolamine (amides and soaps).
Trimethylolethane (esters).
Zinc hydroxide (soaps).

(3) Miscellaneous:

Alcohols and ketone alcohols mixture (still-bottom product from C_{12}-C_{18} alcohol manufacturing process).
Amyl alcohol.
Butoxy polyethylene polypropylene glycol molecular weight 900-4,200.
Butoxy-polyoxypropylene molecular weight 1,000-2,500.
Butylated hydroxyanisole.
Butylated hydroxytoluene.
Calcium lignin sulfonate.
Capryl alcohol.
p-Chlorometacresol.
Cyclohexanol.
Diacetyltartaric acid ester of tallow monoglyceride.
Diethanolamine.
Diethylene triamine.
Di-(2-ethylhexyl) phthalate.
2,6-Dimethyl heptanol-4 (nonyl alcohol).
Dimethylpolysiloxane.
Di-*tert*-butyl hydroquinone.
Dodecylbenzene sulfonic acids.
Ethanol.
2-Ethylhexanol.
Ethylenediamine tetraacetic acid tetrasodium salt.
Formaldehyde.
Heavy oxo-fraction (a still-bottom product of iso-octyl alcohol manufacture, of approximate composition: Octyl alcohol 5 percent nonyl alcohol 10 percent, decyl and higher alcohols 35 percent, esters 45 percent, and soaps 5 percent).
2-Heptadecenyl-4-methyl-4-hydroxymethyl-2-oxazoline.
Hexylene glycol (2-methyl-2-4-pentanediol).
12-Hydroxystearic acid.
Isobutanol.
Isopropanol.
Isopropylamine salt of dodecylbenzene sulfonic acid.
Kerosine.
Lanolin.
Methanol.
Methyl 12-hydroxystearate.
Methyl taurine-oleic acid condensate, molecular weight 486.
α,α'-[Methylenebis[4-(1,1,3,3-tetramethylbutyl)-*o*-phenylene]]*bis*[*omega*-hydroxypoly (oxyethylene)] having 6-7.5 moles of ethylene oxide per hydroxyl group.
Mineral oil.
Mono-, di-, and triisopropanolamine.
Mono- and diisopropanolamine stearate.
Monobutyl ether of ethylene glycol.
Monoethanolamine.
Morpholine.
Myristyl alcohol.
Naphtha.
β-Naphthol.
Nonylphenol.
Odorless light petroleum hydrocarbons.
Oleyl alcohol.
Petrolatum.
o-Phenylphenol.
Pine oil.
Polybutene, hydrogenated; complying with the identity prescribed under § 178.3740(b) of this chapter.
Polyethylene.
Polyethylene, oxidized (air-blown).
Polymer derived from *N*-vinyl pyrrolidone and copolymers derived from the mixed alkyl (C_{12}-C_{16}, C_{16}, C_{18}, C_{20}, and C_{22}) methacrylate esters, butyl methacrylate (CAS Reg. No. 97-88-1), isobutyl methacrylate (CAS Reg. No. 97-86-9) and methyl methacrylate (CAS Reg. No. 80-62-6); the combined polymer contains no more than 5 weight percent of polymer units derived from *N*-vinyl pyrrolidone and is present at a level not to exceed 7 parts per million by weight of the finished dry paper and paperboard fibers.
Polyoxyethylene (4 mols) decyl phosphate.
Polyoxyethylene (4 mols) di(2-ethyl hexanoate).
Polyoxyethylene (15 mols) ester of rosin.
Polyoxyethylene (3-15 mols) tridecyl alcohol.
Polyoxypropylene, molecular weight 200-2,000.
Polyoxypropylene-polyoxethylene condensate, minimum molecular weight 950.
Polyoxypropylene-ethylene oxide condensate of ethylene diamine, molecular weight 1,700-3,800.
Polyvinyl pyrrolidone, molecular weight 40,000.
Potassium distearyl phosphate.
Potassium pentachlorophenate.
Potassium trichlorophenate.
Rosins and rosin derivatives identified in § 175.105(c)(5) of this chapter.
Silica.
Siloxanes and silicones, dimethyl, methylhydrogen, reaction products with polyethylene-polypropylene glycol monoallyl ether (CAS Reg. No. 71965-38-3).
Sodium alkyl (C_9-C_{11}) benzene-sulfonate.
Sodium dioctyl sulfosuccinate.
Sodium distearyl phosphate.
Sodium lauryl sulfate.
Sodium lignin sulfonate.
Sodium 2-mercaptobenzothiazole.

Sodium naphthalenesulfonic acid (3 mols) condensed with formaldehyde (2 mols).
Sodium orthophenylphenate.
Sodium pentachlorophenate.
Sodium petroleum sulfonate, molecular weight 440-450.
Sodium trichlorophenate.
Stearyl alcohol.
α-[*p*-(1,1,3,3-Tetramethylbutyl) phenyl-, *p*-nonylphenyl-, or *p*-dodecylphenyl)-*omega*-hydroxypoly(oxyethylene) produced by the condensation of 1 mole of *p*-alkylphenol (alkyl group is 1,1,3,3-tetramethylbutyl, a propylene trimer isomer, or a propylene tetramer isomer) with an average of 1.5-15 moles of ethylene oxide.
Tetrahydrofurfuryl alcohol.
Tributoxyethyl phosphate.
Tributyl phosphate.
Tridecyl alcohol.
Triethanolamine.
Triethylene glycol di(2-ethyl hexanoate).
Tri-(2-ethylhexyl) phosphate.
Tristearyl phosphate.
Wax, petroleum, Type I and Type II.
Wax, petroleum (oxidized).
Wax (montan).

[42 FR 14554, Mar. 15, 1977, as amended at 47 FR 17986, Apr. 27, 1982; 47 FR 46495, Oct. 19, 1982; 47 FR 56845, Dec. 21, 1982; 54 FR 24897, June 12, 1989]

§ 176.230 3,5-Dimethyl-1,3,5,2*H*-tetrahydrothiadiazine-2-thione.

3,5-Dimethyl-1,3,5,2*H*-tetrahydrothiadiazine-2-thione may safely be used as a preservative in the manufacture and coating of paper and paperboard intended for use in contact with food in accordance with the following prescribed conditions:

(a) It is used as follows:

(1) In the manufacture of paper and paperboard as a preservative for substances added to the pulp suspension prior to the sheet-forming operation provided that the preservative is volatilized by heat in the drying and finishing of the paper and paperboard.

(2) As a preservative for coatings for paper and paperboard, *Provided*, That the preservative is volatilized by heat in the drying and finishing of the coated paper or paperboard.

(b) The quantity used shall not exceed the least amount reasonably required to accomplish the intended technical effect and shall not be intended to nor, in fact, accomplish any physical or technical effect in the food itself.

(c) The use of a preservative in any substance or article subject to any regulation in parts 174, 175, 176, 177, 178 and § 179.45 of this chapter must comply with any specifications and limitations prescribed by such regulation for the substance or article.

§ 176.250 Poly-1,4,7,10,13-pentaaza-15-hydroxyhexadecane.

Poly-1,4,7,10,13-pentaaza-15-hydroxyhexadecane may be safely used as a retention aid employed prior to the sheet-forming operation in the manufacture of paper and paperboard intended for use in contact with food in an amount not to exceed that necessary to accomplish the intended physical or technical effect and not to exceed 6 pounds per ton of finished paper or paperboard.

§ 176.260 Pulp from reclaimed fiber.

(a) Pulp from reclaimed fiber may be safely used as a component of articles used in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food, subject to the provisions of paragraph (b) of this section.

(b) Pulp from reclaimed fiber is prepared from the paper and paperboard products described in paragraphs (b) (1) and (2) of this section, by repulping with water to recover the fiber with the least possible amount of nonfibrous substances.

(1) Industrial waste from the manufacture of paper and paperboard products excluding that which bears or contains any poisonous or deleterious substance which is retained in the recovered pulp and that migrates to the food, except as provided in regulations promulgated under sections 406 and 409 of the Federal Food, Drug, and Cosmetic Act.

(2) Salvage from used paper and paperboard excluding that which (i) bears or contains any poisonous or deleterious substance which is retained in the recovered pulp and that migrates to the food, except as provided in regulations promulgated under sections 406 and 409 of the act or (ii) has been used for shipping or handling any such substance.

§ 176.300 Slimicides.

(a) Slimicides may be safely used in the manufacture of paper and paperboard that contact food, in accordance with the following prescribed conditions:

(1) Slimicides are used as antimicrobial agents to control slime in the manufacture of paper and paperboard.

(2) Subject to any prescribed limitations, slimicides are prepared from one or more of the slime-control substances named in paragraph (c) of this section to which may be added optional adjuvant substances as provided for under paragraph (d) of this section.

(3) Slimicides are added to the process water used in the production of paper or paperboard, and the quantity added shall not exceed the amount necessary to accomplish the intended technical effect.

(b) To insure safe usage, the label or labeling of slimicides shall bear adequate directions for use.

(c) Slime-control substances permitted for use in the preparation of slimicides include substances subject to prior sanction or approval for such use and the following:

List of substances	Limitations
Acrolein	
Alkenyl (C_{14}-C_{18}) dimethylethyl-ammonium bromide	
n-Alkyl (C_{12}-C_{16}) dimethyl benzyl ammonium chloride	
1,2-Benzisothiazolin-3-one	At a level of 0.06 pound per ton of dry weight fiber.
Bis(1,4-bromoacetoxy)-2-butene	
5,5-Bis(bromoacetoxymethyl) *m*-dioxane	
2,6-Bis(dimethylaminomethyl) cyclohexanone	
1,2-Bis(monobromoacetoxy) ethane [CA Reg. No. 3785-34-0]	At a maximum level of 0.10 pound per ton of dry weight fiber.
Bis(trichloromethyl)sulfone	
4-Bromoacetoxymethyl-*m*-dioxolane	
2-Bromo-4'-hydroxyacetophenone	
2-Bromo-2-nitropropane-1,3-diol (CAS Reg. No. 52-51-7)	At a maximum level of 0.6 pound per ton of dry weight fiber.
β-Bromo-β-nitrostyrene	At a maximum level of 1 pound per ton of dry weight fiber.
Chloroethylenebisthiocyanate	
5-Chloro-2 - methyl - 4 - isothiazolin-3-one calcium chloride and 2-methyl-4-isothiazolin-3-one calcium chloride mixture at a ratio of 3 parts to 1 part.	At a level of 2.5 pounds per ton of dry weight fiber.
Chlorinated levulinic acids	
Chloromethyl butanethiolsulfonate	
Cupric nitrate	
n-Dialkyl (C_{12}-C_{16}) benzylmethylammonium chloride	
1,2-Dibromo-2,4-dicyanobutane (CAS Reg. No. 35691-65-7)	At a maximum level of 0.005% of dry weight fiber.
2,2-Dibromo-3-nitrilopropionamide	At a maximum level of 0.1 lb/ton of dry weight fiber.
2,3-Dibromopropionaldehyde	
3,5-Dimethyl 1,3,5,2*H*-tetrahydrothiadiazine-2-thione	
Dipotassium and disodium ethylenebis(dithiocarba-mate)	
Disodium cyanodithioimidocarbonate	
n-Dodecylguanidine hydrochloride	At a maximum level of 0.20 pound per ton of dry weight fiber.
Glutaraldehyde (CAS Reg. No. 111-30-8)	
2-(*p*-hydroxyphenyl) glyoxylohydroximoyl chloride (CAS Registry No. 34911-46-1).	At a level of 0.02 pound per ton of dry weight fiber.
2-Hydroxypropyl methanethiol sulfonate	
2-Mercaptobenzothiazole	
Methylenebisbutanethiolsulfonate	
Methylenebisthiocyanate	
2-Nitrobutyl bromoacetate [CA Reg. No. 32815-96-6]	At a maximum level of 0.15 pound per ton of dry weight fiber.
N-[α-(Nitroethyl)benzyl] ethylenediamine	
Potassium 2-mercaptobenzothiazole	
Potassium *N*-hydroxymethyl-*N*-methyldithiocarba-mate	
Potassium *N*-methyldithiocarbamate	
Potassium pentachlorophenate	
Potassium trichlorophenate	
Silver fluoride	Limit of addition to process water not to exceed 0.024 pound, calculated as silver fluoride, per ton of paper produced.
Silver nitrate	
Sodium dimethyldithiocarbamate	
Sodium 2-mercaptobenzothiazole	
Sodium pentachlorophenate	
Sodium trichlorophenate	
1,3,6,8-Tetraazatricyclo[6.2.1.1 ^{3,6}] dodecane	

APPENDIX II

Material Safety Data Sheets
(MSDS)

ASTRO PRODUCT CODE # 10201

Great Lakes Chemical Corporation

MATERIAL SAFETY DATA SHEET

MATERIAL IDENTIFIER: QO® THFA®

DATE PREPARED: 11/16/95

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	QO® THFA®
CHEMICAL NAME:	TETRAHYDROFURFURYL ALCOHOL
CHEMICAL FAMILY:	ALCOHOL
PRODUCT DESCRIPTION:	CLEAR COLORLESS LIQUID
PRODUCT USE:	SOLVENT, CHEMICAL INTERMEDIATE

MANUFACTURER'S ADDRESS: Great Lakes Chemical Corporation
One Great Lakes Blvd.
P.O. Box 2200
West Lafayette, IN 47906

EMERGENCY TELEPHONE NUMBERS:
CHEMTREC: 1-800-424-9300
HAZARD INFORMATION SERVICES: 1-800-228-5635
(For Emergency Medical Information)

PRODUCT INFORMATION AND OTHER CALLS:
GREAT LAKES CHEMICAL CORPORATION
1-317-497-6100 [9AM-4PM EST M-F]

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT: Tetrahydrofurfuryl alcohol , 98-100% CAS# 97-99-4

SECTION 3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Combustible, clear liquid. Irritating to the eyes and skin.
Prolonged exposure to vapor may cause central nervous system depression.

POTENTIAL HEALTH EFFECTS (See Section 11):

EYE CONTACT: Moderately irritating to eyes.

SKIN CONTACT: Slightly irritating to skin.

INHALATION: Excessive exposure to vapor may cause dizziness, blurred vision, nausea, vomiting or headaches.

INGESTION: May be harmful if ingested.

OTHER EFFECTS: Repeated or prolonged exposure to vapors may cause central nervous system depression, and decreased male fertility. Repeated or prolonged dermal contact may cause decreased male fertility.

CARCINOGENICITY: Not listed as carcinogen by NTP or IARC, not regulated by OSHA.

SECTION 4 FIRST AID MEASURES

EYE CONTACT: Flush with large volumes of water for at least 15 minutes. Get medical attention.

SKIN CONTACT: Wash with large volumes of soap and water. If irritation occurs, get medical attention.

INHALATION: Remove person to fresh air. If not breathing, give artificial respiration. If breathing difficult give oxygen. Get medical attention.

INGESTION: If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.

SECTION 5 FIRE-FIGHTING MEASURES

FLASHPOINT: 165°F (74°C) TCC method
FLAMMABLE LIMITS (%Volume): UEL=9.7 LEL= 1.5
AUTOIGNITION TEMPERATURE: 540°F (282°C)

GENERAL HAZARD: Combustible liquid.

FIRE FIGHTING: Firefighters should have eye protection and wear self-contained breathing apparatus. Use water spray to cool containers exposed to fire.
EXTINGUISHING MEDIA: Alcohol foam, carbon dioxide, dry chemical, water spray for dilution to non-flammable mixture.
DECOMPOSITION PRODUCTS UNDER FIRE CONDITIONS: Combustion produces carbon dioxide and carbon monoxide.

SECTION 6 ACCIDENTAL RELEASE MEASURES

LAND SPILL : Pick up spill on sand, earth or other non-combustible, absorbent material. Flush area with water to remove last traces. Collect wash water/material for disposal. Wear all appropriate personal protective equipment.

SECTION 7 STORAGE AND HANDLING

STORAGE AND HANDLING: Store in cool, dry, well ventilated location. Outside or detached storage is preferred. Separate from oxidizers. Keep containers tightly closed. No smoking or eating in handling area. Avoid contact with skin, eyes and clothing. Avoid breathing mists and vapors. Avoid prolonged and repeated exposure. Use appropriate personal protective equipment. Do not wear contact lenses when working with this material.

Product Number:**T12653**
Product Name:**Tetrahydrofurfuryl alcohol, 98%**

Description / Pricing
Cert. of Analysis
MSDS

Print Preview
Bulk Quote
Ask A Scientist

Valid 08/2000 - 10/2000

Aldrich Chemical Co., Inc.
1001 West St. Paul
Milwaukee, WI 53233 USA
Phone: 414-273-3850

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - -
CATALOG #: T12653
NAME: TETRAHYDROFURFURYL ALCOHOL, 98%
SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -
CAS #: 97-99-4
MF: C5H10O2
EC NO: 202-625-6
SYNONYMS
FURFURYL ALCOHOL, TETRAHYDRO- * QO THFA * TETRAHYDRO-2-FURANCARBINOL * TETRAHYDRO-2-FURANMETHANOL * TETRAHYDROFURFURYL ALCOHOL * TETRAHYDROFURYLALKOHOL (CZECH) * TETRAHYDROFURFURYLALKOHOL (CZECH) * TETRAHYDRO-2-FURYLMETHANOL * THFA *
SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -
LABEL PRECAUTIONARY STATEMENTS
HARMFUL
HARMFUL IF SWALLOWED.
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
COMBUSTIBLE.
KEEP AWAY FROM HEAT AND OPEN FLAME.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
HYGROSCOPIC
SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -
EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
COMBUSTIBLE.
SECTION 6. - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -
REFER TO SECTION 8.
SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -
WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
DO NOT BREATHE VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
WASH THOROUGHLY AFTER HANDLING.
HARMFUL LIQUID.
IRRITANT.
KEEP CONTAINER CLOSED.
KEEP AWAY FROM HEAT AND OPEN FLAME.
HYGROSCOPIC
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

APPEARANCE AND ODOR

COLORLESS LIQUID

PHYSICAL PROPERTIES

MELTING POINT:	-80 C
FLASHPOINT	183F
	83.88C
EXPLOSION LIMITS IN AIR:	
UPPER	9.7%
LOWER	1.5%
VAPOR PRESSURE:	2.3MM 39 C
SPECIFIC GRAVITY:	1.054
VAPOR DENSITY:	3.52

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

INCOMPATIBILITIES

STRONG ACIDS
STRONG OXIDIZING AGENTS
STRONG REDUCING AGENTS
ACID CHLORIDES
ACID ANHYDRIDES

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS

HARMFUL IF SWALLOWED.
MAY BE HARMFUL IF INHALED.
MAY BE HARMFUL IF ABSORBED THROUGH THE SKIN.
CAUSES EYE IRRITATION.
CAUSES SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
EXPOSURE CAN CAUSE:
NAUSEA, DIZZINESS AND HEADACHE
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

RTECS #: LU2450000

2-FURANMETHANOL, TETRAHYDRO-

IRRITATION DATA

EYE-RBT 20 MG/24H MOD	85JCAE -,786,1986

TOXICITY DATA

ORL-RAT LD50:1600 MG/KG	38MKAJ 2C,4658,1982
IPR-RAT LD50:400 MG/KG	38MKAJ 2C,4658,1982
ORL-MUS LD50:2300 MG/KG	HYSAAV 32(2),273,1967
IVN-RBT LD50:725 MG/KG	FEPRA7 8,294,1949
ORL-GPG LD50:800 MG/KG	38MKAJ 2C,4658,1982
SKN-GPG LD50:5 GM/KG	38MKAJ 2C,4658,1982
IPR-GPG LD50:400 MG/KG	38MKAJ 2C,4658,1982

TARGET ORGAN DATA

PATERNAL EFFECTS (SPERMATOGENESIS)
PATERNAL EFFECTS (TESTES, EPIDIDYMIS, SPERM DUCT)
PATERNAL EFFECTS (PROSTATE, SEMINAL VESICLE, COWPER'S, ACCESSORY GLANDS
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

THIS COMBUSTIBLE MATERIAL MAY BE BURNED IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

EUROPEAN INFORMATION

EC INDEX NO: 603-061-00-7
HARMFUL
R 36
IRRITATING TO EYES.
S 39
WEAR EYE/FACE PROTECTION.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
NOHS 1974: HZD 83085; NIS 9; TNF 1654; NOS 9; TNE 2169
NOES 1983: HZD 83085; NIS 41; TNF 5004; NOS 33; TNE 81543; TFE 48075
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1999

SECTION 16. - - - - - - - - - OTHER INFORMATION- - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29CFR 1910.1200. Standard must be consulted for specific requirements.

QO® THFA ®

QO® THFA® High Purity

DATE PREPARED: November 2, 1999

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: QO® THFA® , QO® THFA®-High Purity

CHEMICAL NAME: TETRAHYDROFURFURYL ALCOHOL, THFA

CHEMICAL FAMILY: ALCOHOL

PRODUCT DESCRIPTION: CLEAR COLORLESS LIQUID

PRODUCT USE: SOLVENT, CHEMICAL INTERMEDIATE

MANUFACTURER'S ADDRESS: Penn Specialty Chemicals, Inc.
3324 Chelsea Avenue
Memphis, TN 38108

EMERGENCY TELEPHONE NUMBERS:
CHEMTREC: 800-424-9300
EMERGENY MEDICAL: 800-228-5635
(Hazard Information Services)

PRODUCT INFORMATION AND OTHER CALLS:
Penn Specialty Chemicals, Inc.
901-320-4000

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT: Tetrahydrofurfuryl alcohol, 98-100% CAS# 97-99-4

SECTION 3 HAZARDS IDENTIFICATION

!!! *EMERGENCY OVERVIEW*!!
Combustible, clear liquid. Irritating to the eyes and skin.
Prolonged exposure to vapor may cause central nervous system depression.

POTENTIAL HEALTH EFFECTS (See Section 11):

EYE CONTACT: Moderately irritating to eyes.

SKIN CONTACT: Slightly irritating to skin.

INHALATION: Excessive exposure to vapor may cause dizziness, blurred vision, nausea, vomiting or headaches.

INGESTION: May be harmful if ingested.

OTHER EFFECTS: Repeated or prolonged exposure to vapors may cause central nervous system depression, and decreased male fertility. Repeated or prolonged dermal contact may cause decreased male fertility. Ingestion may cause developmental effects.

CARCINOGENICITY: Not listed as carcinogen by NTP or IARC, not regulated by OSHA.

SECTION 4 FIRST AID MEASURES

EYE CONTACT: Flush with large volumes of water for at least 15 minutes. Get medical attention.

SKIN CONTACT: Wash with large volumes of soap and water. If irritation occurs, get medical attention.

INHALATION: Remove person to fresh air. If not breathing, give artificial respiration. If breathing difficult give oxygen. Get medical attention.

INGESTION: If conscious, give person 1 to 2 glasses of water. Get medical attention immediately.

SECTION 5 FIRE-FIGHTING MEASURES

FLASHPOINT: 165°F (74°C) TCC method
FLAMMABLE LIMITS (%Volume): UEL=9.7 LEL= 1.5
AUTOIGNITION TEMPERATURE: 540°F (282°C)

GENERAL HAZARD: Combustible liquid.

FIRE FIGHTING: Firefighters should have eye protection and wear self-contained breathing apparatus. Use water spray to cool containers exposed to fire.

EXTINGUISHING MEDIA: Alcohol foam, carbon dioxide, dry chemical, water spray for dilution to non-flammable mixture.

DECOMPOSITION PRODUCTS UNDER FIRE CONDITIONS: Combustion produces carbon dioxide and carbon monoxide.

SECTION 6 ACCIDENTAL RELEASE MEASURES

LAND SPILL : Pick up spill on sand, earth or other non-combustible, absorbent material. Flush area with water to remove last traces. Collect wash water/material for disposal. Wear all appropriate personal protective equipment.

SECTION 7 STORAGE AND HANDLING

STORAGE AND HANDLING: Store in cool, dry, well ventilated location. Outside or detached storage is preferred. Separate from oxidizers. Keep containers tightly closed. No smoking or eating in handling area.

Avoid contact with skin, eyes and clothing. Avoid breathing mists and vapors. Avoid prolonged and repeated exposure. Use appropriate personal protective equipment. Do not wear contact lenses when working with this material.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

WORKPLACE EXPOSURE GUIDELINES: Avoid direct contact with tetrahydrofurfuryl alcohol. General ventilation and local exhaust required to minimize exposure to mists and vapors.

OSHA PEL - Not Established. **ACGIH TLV** - Not Established. **AIHA WEEL GUIDE**: 2ppm (8hr TWA).

PERSONAL PROTECTION: If misting or vapors occur use NIOSH approved organic vapor air purifying respirator. Use chemical safety goggles for eye protection. Use impervious chemical gloves (North Safety Products, Silver Shield). Have eye wash and safety shower available.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

SPECIFIC GRAVITY: 1.05

VAPOR PRESSURE: mmHg: 0.2 at 68 °F (20°C)

SOLUBILITY IN WATER: Complete.

APPEARANCE: Clear, water white to pale yellow, mobile liquid.

VAPOR DENSITY at 1 atm (Air=1): 3.5

FREEZING/MELTING POINT: -112°F (-80° C)

BOILING POINT: 352°F (178°C)

pH: not available

ODOR: Mild characteristic odor.

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Stable.

HAZARDOUS POLYMERIZATION: None.

INCOMPATIBLE MATERIALS: oxidizers, strong acids, strong bases.
CONDITIONS TO AVOID: heat, sparks, flame or other sources of ignition.
HAZARDOUS DECOMPOSITION PRODUCTS: Combustion produces carbon dioxide and carbon monoxide.

SECTION 11 TOXICOLOGICAL INFORMATION

COMPONENT	ACUTE TEST	VALUE	SPECIES
THFA®	Oral LD50	1600 mg/Kg*	Rat
	Intraperitoneal LD50	400 mg/Kg*	Rat
	Oral LD50	2300 mg/Kg*	Mouse
	Intravenous LD50	725 mg/Kg*	Rabbit

Oral LD50	800 mg/Kg*		Guinea pig
Dermal LD50	≠5 mg/Kg*		Guinea pig
Intraperitoneal LD50	400 mg/Kg*	Guinea pig	

*RTECS Reference

≠ value typed incorrectly. Should be 5g/kg.

ACUTE EFFECTS: Moderately irritating to eyes, skin and mucous membranes. Moderately toxic by ingestion.

SUBCHRONIC EFFECTS: Subchronic exposures (oral, dermal and inhalation) at relatively high levels, have demonstrated systemic toxicity, reproductive toxicity, and central nervous system depression in either rats, rabbits or dogs. An oral developmental screening study in rats expressed a lower mean fetal body weight at
100 mg/kg/day.

CHRONIC EFFECTS: Not available
MUTAGENICITY: Not mutagenic by the Ames test.

SECTION 12 ECOLOGICAL INFORMATION

Tetrahydrofurfuryl alcohol readily biodegrades in soil, sludge and water. The atmospheric half-life is 13 hours. (Reference: HSDB of the National Library of Medicine)

SECTION 13 DISPOSAL CONSIDERATIONS

Tetrahydrofurfuryl alcohol is not an EPA hazardous waste. Dispose of in accord with regulations.

SECTION 14 TRANSPORT INFORMATION

DEPARTMENT OF TRANSPORTATION (DOT): Combustible liquid, N.O.S. (Tetrahydrofurfuryl alcohol), NA 1993, Packing Group III. Label: None.
49CFR173.150: Combustible liquids in non-bulk packaging are not regulated by DOT.

SECTION 15 REGULATORY INFORMATION

INVENTORY LISTINGS: Tetrahydrofurfuryl alcohol is listed on the TSCA, DSL, and EINECS inventories.

SECTION 16 OTHER INFORMATION

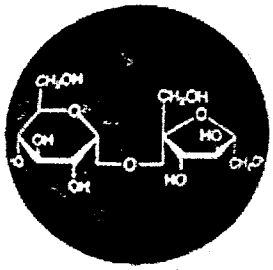
HAZARD RATING SYSTEMS: NFPA Hazard Identification: HEALTH **2**, FLAMMABILITY **2**, REACTIVITY **0**.

REVISION: 11/99 Change Company Name

SUPERSEDES ISSUE DATE: 11/6/96

APPENDIX III

General Information on Production, Nomenclature and Product Uses



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Great Lakes Chemical Corp.

TETRAHYDROFURFURYL ALCOHOL

TETRAHYDROFURFURYL ALCOHOL [97-99-4] Colorless, water-miscible, biodegradable, high- boiling, environmentally acceptable solvent used as biocide carrier in industrial cleaners, coating remover (paints, inks, etc.) chemical intermediates, etc Industrial, 98% grades UN 1987, alcohol, NOS, combustible liquid Tank car, tank truck

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Pubs Page / ChemCenter / ChemPort / CAS

FROM CHEMID

Name of Substance

- 2-Furanmethanol, tetrahydro-
- Tetrahydro-2-furanmethanol
- Tetrahydrofurfuryl alcohol

Superlist Name

- 2-Furanmethanol, tetrahydro-
- Furfuryl alcohol, tetrahydro-
- Tetrahydrofurfuryl alcohol

Synonyms

- 2-(Hydroxymethyl)tetrahydrofuran
- 2-Furanmethanol, tetrahydro-
- 5-17-03-00115 (Beilstein Handbook Reference)
- AI3-00104
- BRN 0102723
- CCRIS 2923
- EINECS 202-625-6
- FEMA No. 3056
- Furfuryl alcohol, tetrahydro-
- HSDB 5314
- NSC 15434
- QO Thfa
- THFA
- Tetrahydro-2-furancarbinol
- Tetrahydro-2-furanmethanol
- Tetrahydro-2-furanylmethanol
- Tetrahydro-2-furfuryl alcohol
- Tetrahydro-2-furylmethanol
- Tetrahydrofurfuryl alcohol
- Tetrahydrofurfurylalkohol [Czech]
- Tetrahydrofuryl carbinol
- Tetrahydrofurylalkohol [Czech]

FROM CHEMID

Systematic Name

- 2-Furanmethanol, tetrahydro-
- Furfuryl alcohol, tetrahydro- (8CI)
- Tetrahydrofurfuryl alcohol

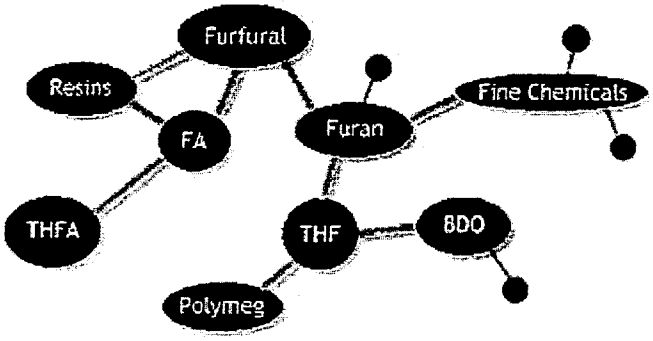
PENN Specialty Chemicals, Inc.

21st Century Technology and a Rennaissance in Service

You can go directly to our
Download Site for:
MSDS information
Sales Specification Sheets

Solvents Product Listing
MSDS and Sales Specs

Get Acrobat Reader



Solvents

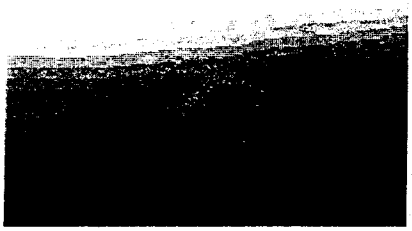
Furfural, Furfuryl Alcohol and THFA

Furfural

Furfural was discovered by Dobereiner in 1832, and commercial production was pioneered by The Quaker Oats Company in 1922. Furfural has grown to industrial importance chiefly because it is an excellent solvent and the precursor of many commercial chemicals. It is obtained from pentosan-containing agricultural residues such as corn cobs, bagasse, cottonseed hulls, oat hulls and rice hulls.

Furfuryl Alcohol

Furfuryl alcohol is produced by the catalytic hydrogenation of furfural. Furfuryl alcohol undergoes the typical reactions of a primary alcohol including oxidation, esterification and estherification. It is used extensively in the foundry industry.



Tetrahydrofurfuryl Alcohol (THFA)

THFA is an environmentally acceptable, biodegradeable and water misceable specialty solvent. It is a clear, colorless, neutral solvent that is not photochemically reactive,

http://www.paddocklabs.com/publications/secundum/secart32.html

Current and Practical Compounding Information for the Pharmacist

Compounding Topical Dosage Forms: Ointments, Creams, Pastes and Lotions

Loyd V. Allen, Jr., R.Ph., Ph.D.
Professor and Head, Pharmaceutics and Medicinal Chemistry
University of Oklahoma HSC College of Pharmacy

Contents:

Absorption Enhancers

This class of additives deserves brief mention here, but will be covered in depth in a future issue.
Absorption enhancers have attracted attention in the popular and scientific literature, particularly since the transdermal route of administration has become more widely used. These substances facilitate absorption of drugs through the skin. It appears that some materials have a direct effect on the permeability of the skin and others augment percutaneous absorption by increasing the thermodynamic activity of the penetrant, thus creating a greater concentration gradient across the skin.
Direct-effect absorption enhancers include common as well as not-so-common chemicals, including solvents, surfactants, and chemicals such as urea and N, N-diethyl-m-toluamide.
Water is the most prevalent absorption enhancer, even in "anhydrous" systems because of their occlusive nature. The classic absorption enhancer is dimethylsulfoxide (DMSO), which has lost popularity due to adverse side effects. However, other solvents such as laurocapram (Azone) have been shown to be very effective, even in concentrations below 5%, because they are retained in the stratum corneum for a period of time, which prolongs their effect.
Surfactants have functioned as absorption enhancers, but they do cause irritation, which limits their usefulness.
Examples of absorption enhancers are shown in Table 3.

Table 3: Absorption Enhancers

Solvents
Water
Alcohols (Methanol, Ethanol, 2-propanol)
Alkyl methyl sulfoxides (Dimethyl sulfoxide, Decylmethyl sulfoxide, Tetradecyl methyl sulfoxide)
Pyrrolidones (2-Pyrrolidone, N-Methyl-2-pyrrolidone, N-(2-Hydroxyethyl) pyrrolidone
Laurocapram
Miscellaneous: (Acetone, Dimethyl acetamide, Dimethyl formamide, Tetrahydrofurfuryl alcohol)

Amphiphiles
Anionic surfactants (docusate sodium, sodium lauryl sulfate)
Cationic surfactants (quaternary ammonium salts)
Amphoteric surfactants (lecithins, cephalins, alkylbetamines)
Nonionic surfactants (mono-, di-, and triglycerides)
Fatty acids and alcohols (lauryl, cetyl, and stearyl alcohols; sucrose, sorbitan, PEG)

Miscellaneous
Urea
N, N-Diethyl-m-toluamide

Yauyip Pty Lt

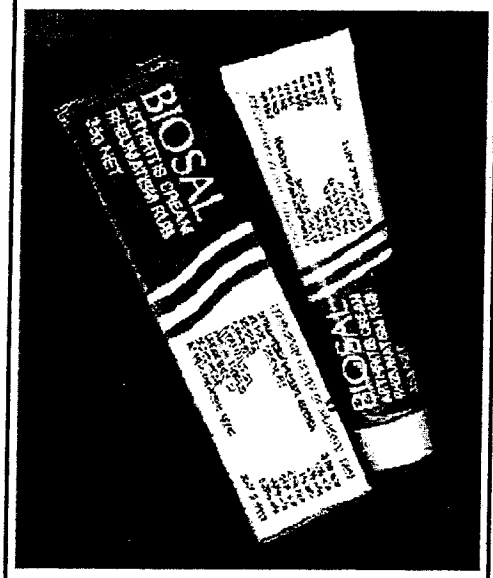
"Natural re

Supplier Details

Supplier:
Yauyip Pty Ltd
Address:
22 Wilson St,
Strathfield NSW
2135
Phone:
(02) 9746 5353
Fax:
(02)97465353
Email

How to Order

1. **Mail:**
   Yauyip Pty Ltd, 22 Wilson St,
   Strathfield NSW 2135



Biosal Arthritis Cream

Biosal Arthritis Cream Rheumatism Rub is for temporary relief from Arthritis pain.

Price: $10 AUD
Tip: Convert AUD into your local currency.

RETAIL EXPORT INVEST

THFA

Additional Information:

Biosal Arthritis Cream contains Tetrahydrofurfuryl alcohol which may help improve the circulation of th skin.

It requires less vigorous massage of the cream into the skin to produce a feeling of warmth.

Methyl Salicylate has been traditionally used in liniments with the distinct smell of Oil of Wintergreen

These ingredients in combination with Menthol, Pine Oil and Eucalyptus Oil have helped many people ga temporary relief of arthritic pain by massaging the cream gently into the painful area.

Biosal Arthritis Cream is available in 35g tubes fro selected pharmacies and also by mail order.

Mail Order: Prices include postage and handling. Three packs are available for the special price of jus $25.

[CBI-DELETED COPY]

APPENDIX III

AMVAC Product Labels Deleted in this Appendix

APPENDIX IV

EPA and Other Third Party Hazards and Risk Summaries

EPA United States Environmental Protection Agency

Envirofacts Warehouse | Chemical References | Index | Query | Model | Feedback | EF Home

Envirofacts Warehouse Chemical References

TETRAHYDROFURFURYL ALCOHOL CAS #97-99-4

The following information resources are not maintained by Envirofacts. Envirofacts is neither responsible for their informational content nor for their site operation, but provides references to them here as a convenience to our Internet users.

Reference information on this chemical can be found at the following locations:

Non-Governmental Organizations

- The Environmental Defense Fund's EXIT EPA **Chemical Scorecard** summarizes information about health effects, hazard rankings, industrial and consumer product uses, environmental releases and transfers, risk assessment values and regulatory coverage.

These pages are maintained by the Envirofacts Support Team at the EPA Systems Development Center.
For comments, problems or suggestions, please use the Envirofacts Feedback Form.

This page was updated July 23, 1998.

Chemical: TETRAHYDROFURFURYL ALCOHOL
CAS Number: 97-99-4

Chemical Profile for TETRAHYDROFURFURYL ALCOHOL (CAS Number: 97-99-4)

• Human Health Hazards

Health Hazard	Reference(s)
Recognized:	--
Suspected:	--

[top]

• Hazard Rankings

Data lacking; not ranked by any system in Scorecard.

[top]

• Chemical Use Profile

Used in at least 1 industry.

Used in consumer products, building materials or furnishings that contribute to indoor air pollution.

[top]

- **Rank Chemicals by Reported Environmental Releases in the United States**

No data on environmental releases in Scorecard.

[top]

- **Rank Chemicals by Reported Environmental Releases in Canada**

No data on environmental releases in Canada.

[top]

- **Regulatory Coverage**

Not on chemical lists in Scorecard.

[top]

- **Basic Testing to Identify Chemical Hazards**

Information on whether basic tests to identify chemical hazards have been conducted on this chemical is not available.

[top]

- **Information Needed for Safety Assessment**

Lacks at least some of the data required for safety assessment. See risk assessment data for this chemical from U.S. EPA or Scorecard.

[top]

- **Links**

Other web sites specific to this chemical:
- IPCS International Chemical Safety Card

If none of these sources meet your needs, you can try searching some other chemical database Web sites.

[top]

ENVIRONMENTAL DEFENSE

Home
Find Your Community
What's New
Setting Priorities
Pollution Locator
Pollution Rankings
About the Chemicals
Health Effects
Regulatory Controls
Discussion Forums
FAQs
Personalize Scorecard
Glossary
About the Scorecard
Search Scorecard

Go

Search Tips

PollutionWatch Canada

ABOUT THE CHEMICALS | Industrial Uses

Environmental Defense Scorecard

Chemical: TETRAHYDROFURFURYL ALCOHOL
CAS Number: 97-99-4

Which Industries Use This Chemical?	How is the Chemical Used in This Industry?
Wood Stains and Varnishes	Resin Solvents

ENVIRONMENTAL DEFENSE

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PollutionWatch Canada

ABOUT THE CHEMICALS|Consumer Products

Environmental Defense Scorecard

Chemical: TETRAHYDROFURFURYL ALCOHOL
CAS Number: 97-99-4

What Kinds of Consumer Products May Contain This Chemical?

- Miscellaneous agricultural/pesticidal products
- Oven cleaners
- Paint and varnish removers
- Synthetic resin and rubber adhesives

ENVIRONMENTAL DEFENSE

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ABOUT THE CHEMICALS | National Safety Assessment Data

Environmental Defense Scorecard

Chemical: TETRAHYDROFURFURYL ALCOHOL
CAS Number: 97-99-4

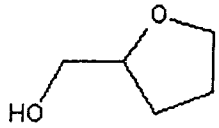
Risk Assessment Values or Standards

	Value	Units	Reference
Inhalation cancer risk value (potency)	Not a recognized or suspect carcinogen		
Inhalation noncancer risk value (reference concentration)	Data gap		
National ambient air quality standard	Gap in regulatory coverage		
Ingestion cancer risk value (potency)	Not a recognized or suspect carcinogen		
Ingestion noncancer risk value (reference dose)	Data gap		
National water quality standard	Gap in regulatory coverage		

See the data Scorecard possesses for safety assessment.

2-Furanmethanol, tetrahydro-

- **Formula:** $C_5H_{10}O_2$
- **Molecular Weight:** 102.13
- **CAS Registry Number:** 97-99-4
- **Chemical Structure:**



This structure is also available as a 2d Mol file.

- **Other Names:** Furfuryl alcohol, tetrahydro-; Qo thfa; Tetrahydro-2-furancarbinol; Tetrahydro-2-furanmethanol; Tetrahydro-2-furanylmethanol; Tetrahydro-2-furfuryl alcohol; Tetrahydro-2-furylmethanol; Tetrahydrofurfuryl alcohol; THFA; 2-Hydroxymethyl-Tetrahydrofuran; Oxolan-2-methanol; α-Tetrahydrofurfuryl alcohol; Tetrahydrofurylalkohol; Tetrahydrofurfurylalkohol; Tetrahydrofurylmethanol
- Notes / Error Report
- **Other Data Available:**
  - Gas phase thermochemistry data
  - Condensed phase thermochemistry data
  - Phase change data
  - Gas Phase IR Spectrum
  - Mass Spectrum
- Switch to calorie-based units

Notes / Error Report

Go To: Top

International Chemical Safety Cards

TETRAHYDROFURFURYL ALCOHOL

ICSC: 1159

Tetrahydro-2-furylmethanol
Tetrahydro-2-furanmethanol
Tetrahydro-2-furancarbinol
2-Hydroxymethyl oxolane
$C_5H_{10}O_2$
Molecular mass: 102.1

ICSC # 1159
CAS # 97-99-4
RTECS # LU2450000
EC # 603-061-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Powder, alcohol-resistant foam, water in large amounts, carbon dioxide.
EXPLOSION	Above 75°C explosive vapour/air mixtures may be formed.	Above 75°C use a closed system, ventilation.	
EXPOSURE			
•INHALATION	Sore throat. Cough. Headache. Nausea. Dizziness. Drowsiness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness. Pain.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Wash away remainder with plenty of water.	Separated from incompatible substances: see Chemical Dangers. Keep in the dark. Store only if stabilized.	Airtight. Xi symbol R: 36 S: 2-39

SEE IMPORTANT INFORMATION ON BACK

International Chemical Safety Cards

TETRAHYDROFURFURYL ALCOHOL

ICSC: 1159

IMPORTANT DATA		
	PHYSICAL STATE; APPEARANCE: COLOURLESS HYGROSCOPIC LIQUID. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** The substance can presumably form explosive peroxides. Reacts violently with strong oxidants, several N-chloro- and N-bromoimides causing fire and explosion hazard. **OCCUPATIONAL EXPOSURE LIMITS:** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and through the skin. **INHALATION RISK:** No indication can be given about the rate in which a harmful concentration in the air is reached on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the central nervous system. Exposure at high level may result in unconsciousness. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
PHYSICAL PROPERTIES	Boiling point: 178°C Melting point: -80°C Relative density (water = 1): 1.05 Solubility in water: good Vapour pressure, Pa at 20°C: 30.6	Relative vapour density (air = 1): 3.5 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.0 Flash point: 75°C o.c. Auto-ignition temperature: 282°C Explosive limits, vol% in air: 1.5-9.7
ENVIRONMENTAL DATA		

NOTES

Use of alcoholic beverages enhances the harmful effect. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Check for peroxides prior to distillation; eliminate if found.

NFPA Code: H 2; F 2; R 0;

ADDITIONAL INFORMATION

ICSC: 1159 TETRAHYDROFURFURYL ALCOHOL

IPCS INCHEM

TETRAHYDROFURFURYL ALCOHOL

Tetrahydro-2-furylmethanol
Tetrahydro-2-furanmethanol
Tetrahydro-2-furancarbinol
2-Hydroxymethyl oxolane

$C_5H_{10}O_2$

Molecular mass: 102.1

CAS # 97-99-4
RTECS # LU2450000
ICSC # 1159
EC # 603-061-00-7

TYPES OF HAZARD/EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Powder, alcohol-resistant foam, water in large amounts, carbon dioxide.
EXPLOSION	Above 75°C explosive vapour/air mixtures may be formed.	Above 75°C use a closed system, ventilation.	
EXPOSURE			
INHALATION	Sore throat, cough, headache, nausea, dizziness, drowsiness, unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest, and refer for medical attention.
SKIN	Redness, pain.	Protective gloves.	Remove contaminated clothes, and rinse and then wash skin with water and soap.
EYES	Redness, pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
INGESTION	Abdominal pain (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth, and refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible, wash away remainder with plenty of water.	Separated from incompatible substances: see Chemical Dangers. Keep in the dark, store only if stabilized.	Airtight. Xi symbol R: 36 S: (2-)39

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS HYGROSCOPIC LIQUID. **CHEMICAL DANGERS:** The substance can presumably form explosive peroxides. Reacts violently with strong oxidants, several N-chloro- and N-bromoimides causing fire and explosion hazard. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established. **ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and through the skin.	**INHALATION RISK:** No indication can be given about the rate in which a harmful concentration in the air is reached on evaporation of this substance at 20° C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the central nervous system. Exposure at high level may result in unconsciousness.
PHYSICAL PROPERTIES	Boiling point: 178°C Melting point: <-80°C Relative density (water = 1): 1.05 Solubility in water: good Vapour pressure, Pa at 20°C: 30.6 Relative vapour density (air = 1): 3.5 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.0 Flash point: 75°C o.c. Auto-ignition temperature: 282°C Explosive limits, vol% in air: 1.5-9.7	
ENVIRONMENTAL DATA		

NOTES
Use of alcoholic beverages enhances the harmful effect. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert, check for peroxides prior to distillation; eliminate if found.
NFPA Code: H 2; F 2; R 0;

ADDITIONAL INFORMATION

See Also: Toxicological Abbreviations

Enter a chemical name, CAS Number, molecular formula, or molecular weight

New Search

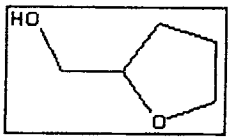
Or choose: Substructure Query with Plug-In or Structure Query with Java

Tetrahydro-2-furanmethanol [97-99-4]

Synonyms: Tetrahydro-2-furylmethanol; Tetrahydrofurfuryl alcohol; THFA;

$C_5H_{10}O_2$

102.1328



View with ChemDraw Plugin
Save in CDX format

BUY AT CHEMACX.COM
VIEW CHEM3D MODEL

Add Compound Add or Change Property Add Link Feedback

ACX Number	X1003437-0	CAS RN	97-99-4
Melting Point (°C)	-80	Density	1.054
Boiling Point (°C)	178	Vapor Density	
Refractive Index		Vapor Pressure	
Evaporation Rate		Water Solubility	
Flash Point (°C)	74	EPA Code	
DOT Number		RTECS	LU2450000

Comments: Liquid. HYGROSCOPIC.

More information about the chemical is available in these categories:

Chemical Online Order Health Misc Physical Properties Regulations

Chemical Online Order

Available Chemicals Exchange

Information about this particular compound

Health

8(e) TRIAGE Chemical Studies Database

Australian Hazardous Substances Database

Information about this particular compound

Information about this particular compound

Misc

Chemical management

Information about this particular compound

Physical Properties

Fragranced Products Information Network

Information about this particular compound

NIST Chemistry WebBook

Information about this particular compound

ABCR GmbH&Co KG

Tetrahydrofurfuryl alcohol, 99%

Proton NMR Spectral Molecular Formula Index

Information about this particular compound

Galactic Industries Corporation Spectral Database

FTIR SPECTRUM of FURFURYL ALCOHOL, TETRAHYDRO-,

Genium's Chemical Container Label Database

Information about this particular compound

NFPA Chemical Hazard Labels

Information about this particular compound

Regulations

OSHA Chemical Sampling and Methods

Information about this particular compound

Enter a chemical name, CAS Number, molecular formula, or molecular weight

Substructure Query with Plug-In or Substructure Query with Java

CHEMFATE Search Results

Return to EFDB page

CAS #: 000097-99-4 Name: TETRAHYDROFURFURYL ALCOHOL

```
**********************************************************************************
ID      TETRAHYDROFURFURYL ALCOHOL                                CAS#     97-99-4
  Preferred Name :  TETRAHYDROFURFURYL ALCOHOL
  9th Col Index  :  TETRAHYDRO-2-FURAN-METHANOL
  Synomym        :  TETRAHYDRO-2-FURANCARBINOL
  Mol. Weight    :  102.13
  Mol. Formula   :  C5H10O2
  Composition    :  C 58.80%, H 9.87%, O 31.33%
**********************************************************************************

VP      TETRAHYDROFURFURYL ALCOHOL                                CAS#     97-99-4
  Vapor Pressure :  8.010E-01   MM HG       MEASURED
  Temperature (C):  25
  Remarks        :  SRC RECOMMENDED VALUE
  Abbrev. Ref.   :  DAUBERT,TE & DANNER,RP (1989)
**********************************************************************************
```

DAUBERT,TE & DANNER,RP (1989)
DAUBERT,T.E.; DANNER, R.P.; PHYSICAL AND THERMODYNAMIC PROPERTIES OF PURE CHEMICALS: DATA COMPILATION.; DESIGN INSTITUTE FOR PHYSICAL PROPERTY DATA, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. HEMISPHERE PUB. CORP., NEW YORK, NY., 4 VOL.; 1989

End of Search

CORNELL UNIVERSITY

pdc

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) Chemical Substances Inventory is the only official source for information. This extract has been prepared for Cornell University user convenience only from the March 2001 update on CD-ROM by SOLUTIONS Software Corporation.

CAS Number: 97-99-4

Preferred CA Index Name: 2-Furanmethanol, tetrahydro-

Submitter Name(s):

Former CAS Number(s): 72074-94-3; 82853-20-1

Molecular Formula: C5H10O2

UVCB Flag:

EPA Flag (s):

Page Created 5/20/2001

7.0 REGISTRY OF CYTOTOXICITY (RC) DATA (ZEBET)

7.1 The ZEBET Database

ZEBET was established in Germany in 1989 at the Federal Institute for Consumer Health Protection and Veterinary Medicine (BgVV; http://www.bgvv.de). The ZEBET database contains evaluated information from the field of biomedicine and related fields on alternative methods that address the 3Rs concept of research that involves animals: refinement of animal use in experimentation, reduction of animal use, and replacement of animals. The database information was obtained from approximately 800 different documents (e.g., books, journals, monographs, etc.). The RC is part of the database and provides *in vitro* IC50 values as well as acute oral toxicity data (LD50) for rats and mice for 347 chemicals. The LD50 values come from the RTECS database at NIOSH. The ZEBET database also includes data for the 50 chemicals from the MEIC database. The German Institute for Medical Documentation and Information (DIMDI) provides access to the ZEBET database (http://www.dimdi.de).

7.1.1 *Tables*

Table 7.1: IC50 values in ascending order (all RC chemicals)
Table 7.2: Rat LD50 oral values in descending order (all RC chemicals)
Table 7.3: Alphabetical order (all RC chemicals)
Table 7.4: Rat LD50 oral values in descending order (MEIC chemicals)

The acute oral toxicity values are provided in mg/kg and mmol/l for rats and mice. Regression calculation values are in the last column of the data sheets. Rat LD50 values were used for the calculations if they were available; if not, then mouse LD50 values were used.

7.1.2 *Figures*

Regression calculations between cytotoxicity and acute oral toxicity are illustrated in the figures following the data.

Figure 7.1: Regression between RC values (IC50x) and acute oral LD50 values (MEIC chemicals)
Figure 7.2: Regression between human cell lines (IC50m) and acute oral LD50 values (MEIC chemicals)

7.1.3 *German Organizational Names*

ZEBET: Zentralstelle zur Erfassung und Bewertungvon Ersatz- und Ergänzungsmethoden zum Tierversuch
(German Centre for the Documentation and Validation of Alternative Methods [at BgVV])

DIMDI: Deutsches Institut für Medizinische Dokumentation und Information
(The German Institute for Medical Documentation and Information)

BgVV: Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin
(Federal Institute for Health Protection of Consumers and Veterinary Medicine)

Section 7.2
Table 7.1
Chemical Data from the Registry of Cytotoxicity Database (Sorted by IC50x mmol/l)

RC #	MEIC #		Chemical	CAS #	IC50x		LD50 RAT		LD50 MOUSE			Rodent LD50 (mmol/kg)
					ug/ml	mmol/l	mg/kg	mmol/kg	mg/kg	mmol/kg	MW	for Regression
318			Trifluoroacetic acid	76-05-1	2337.62	20.5	199.6	1.75	NA	NA	114.03	1.75
127			Dimethyl phthalate	131-11-3	4544.28	23.4	6894.1	35.5	7204.8	37.1	194.2	35.5
319			Methylpentinol	77-75-8	2336.21	23.8	NA	NA	525.2	5.35	98.16	5.35
320		N,N-	Dimethylacetamide	127-19-5	2108.79	24.2	5089.0	58.4	4618.4	53	87.14	58.4
321			Acetic acid	64-19-7	1459.46	24.3	3309.3	55.1	4961.0	82.6	60.06	55.1
322		1-	Pentanol	71-41-0	2195.43	24.9	3033.0	34.4	200.1	2.27	88.17	34.4
323			Urethan	51-79-6	2307.95	25.9	NA	NA	2504.0	28.1	89.11	28.1
324		2-	Butoxyethanol	111-76-2	3073.20	26	1477.5	12.5	1229.3	10.4	118.2	12.5
325			Cyclohexanol	108-93-0	2634.73	26.3	2063.7	20.6	NA	NA	100.18	20.6
326			Halothane	151-67-7	6138.83	31.1	5684.8	28.8	NA	NA	197.39	28.8
327	20		Lithium I sulfate	10377-48-7	3704.98	33.7	NA	NA	1187.4	10.8	109.94	10.8
328	36		Dichloromethane	75-09-2	2964.06	34.9	1596.7	18.8	NA	NA	84.93	18.8
329			Sodium cyclamate	139-05-9	7123.90	35.4	15254.0	75.8	17004.8	84.5	201.24	75.8
330			Sulfuric acid	7664-93-9	3530.88	36	2138.1	21.8	NA	NA	98.08	21.8
331			Strontium II chloride	10476-85-4	5770.13	36.4	2251.0	14.2	3107.0	19.6	158.52	14.2
332		1,4-	Dioxane	123-91-1	3357.37	38.1	4203.3	47.7	5701.4	64.7	88.12	47.7
333			Lithium I chloride	7447-41-8	1636.25	38.6	758.8	17.9	1165.7	27.5	42.39	17.9
334			Isobutanol	78-83-1	2973.01	40.1	2461.4	33.2	NA	NA	74.14	33.2
335			Potassium hexacyano- ferrate II	13943-58-3	15582.05	42.3	6409.6	17.4	5009.8	13.6	368.37	17.4
336			Nicotinamide	98-92-0	5423.02	44.4	3505.4	28.7	NA	NA	122.14	28.7
337			Pyridine	110-86-1	3710.26	46.9	893.9	11.3	NA	NA	79.11	11.3
338		1-	Butanol	71-36-3	3892.35	52.5	793.3	10.7	NA	NA	74.14	10.7
339		1-	Nitropropane	79-46-9	5159.47	57.9	455.4	5.11	NA	NA	89.11	5.11
340			Diethylene glycol	111-46-6	6591.29	62.1	14753.5	139	23669.2	223	106.14	139
341			Lactic acid	598-82-3	5945.94	66	3729.7	41.4	4873.9	54.1	90.09	41.4
342			Piperazine	110-85-0	5789.95	67.2	1904.1	22.1	1438.9	16.7	86.16	22.1
343			Magnesium II chloride * 6 H2O	7791-18-6	14314.43	70.4	8092.5	39.8	NA	NA	203.33	39.8
344	13		Sodium chloride	7647-14-5	4435.60	75.9	2998.0	51.3	3997.3	68.4	58.44	51.3
345			Sodium I bromide	7647-15-6	8120.81	77.4	3504.3	33.4	6998.2	66.7	104.92	33.4
346	50		Potassium I chloride	7447-40-7	6113.10	82	2601.8	34.9	1498.5	20.1	74.55	34.9
347			Thiourea	62-56-6	6547.18	86	124.9	1.64	8526.6	112	76.13	1.64
348		1-	Propanol	71-23-8	5800.62	96.5	5397.9	89.8	NA	NA	60.11	89.8
349			Ethyl methyl ketone	78-93-3	7500.48	104	3396.9	47.1	NA	NA	72.12	47.1
350			Tetrahydrofurfuryl alcohol	97-99-4	11338.65	111	2502.7	24.5	2298.4	22.5	102.15	24.5
351			Dimethylformamide	68-12-2	8334.54	114	2800.1	38.3	3750.5	51.3	73.11	38.3
352		1,2,6-	Hexanetriol	106-69-4	16506.60	123	15969.8	119	NA	NA	134.2	119
353			Ethyl acetate	141-78-6	11279.36	128	11015.0	125	NA	NA	88.12	125
128	10	2-	Propanol	67-63-0	10038.37	167	5842.7	97.2	NA	NA	60.11	97.2
354		1,3,5-	Trioxane	110-88-3	19189.17	213	800.0	8.88	NA	NA	90.09	8.88

APPENDIX V

NPIRS Study Listing

PDMS Search - Display First Submitter Information

Last Search: Administrative Numbers: 2F1198
Citations Selected: 9

00056443 Flint, D.R.; Thornton, J.S.; Shaw, H.R. (1972) A Gas Chromatographic Method for the Determination of Tetrahydrofurfuryl alcohol (THFA) on Food Crops: Report No. 35025. Method dated Nov 6, 1972. (Unpublished study received on unknown date under 2F1198; prepared by Chemagro Corp., submitted by Quaker Oats Co., Chicago, Ill.; CDL:091015-A)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	99/99/99	2F1198	091015 A

00056444 Chemagro (1972) Chemagro Division of Baychem Corporation Residue Experiment: Report No. 35047. (Compilation; unpublished study including report nos. 35048 and 35046, received Apr 30, 1973 under 2F1198; submitted by Quaker Oats Co., Chicago, Ill.; CDL: 091015-B)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	04/30/73	2F1198	091015 B

00056445 Madden, J.W.; Daniels, J. (1972) A Gas Chromatographic Method for the Determination of Tetrahydrofurfuryl alcohol Residues on Crops: Report No. 2. Method dated Jan 27, 1972. (Unpublished study received Feb 7, 1972 under 2F1198; submitted by Quaker Oats Co., Chicago, Ill.; CDL:091015-C)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 C

00056446 Quaker Oats Company (1957) Physiological Data on CO Tetrahydrofurfuryl alcohol. (Unpublished study received Feb 7, 1972 under 2F1198; CDL:091015-D)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 D

00056447 Reineck, E.A. (1971) 90-Day Oral Toxicity of THFA. (Unpublished study received Feb 7, 1972 under 2F1198; submitted by Quaker Oats Co., Chicago, Ill.; CDL:091015-E)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 E

00056448 Chemagro Corporation (1971) Residue of Trichlorfon on Grass, Hay and Alfalfa : Report No. 29683. (Compilation; unpublished study including report nos. 22997 and 20997, received Feb 7, 1972 under 2F1198; submitted by Quaker Oats Co., Chicago, Ill.; CDL:

091015-F)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 F

00056449 Lindberg, D.C.; Richter, W.R. (1971) Report to the Quaker Oats Company: 90-Day Testicular Maturation Study with THFA in Beagle Dogs: IBT No. C9470. (Unpublished study received Feb 7, 1972 under 2F1198; prepared by Industrial Bio-Test Laboratories, Inc., submitted by Quaker Oats Co., Chicago, Ill.; CDL:091015-G)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 G

00056450 Mastalski, K.; Suckow, E.E. (1970) Report to the Quaker Oats Company: Ninety-Day Subacute Oral Toxicity Study of THFA in Beagle Dogs: IBT No. J8493. (Unpublished study received Feb 7, 1972 under 2F1198; prepared by Industrial Bio-Test Laboratories, Inc., submitted by Quaker Oats Co., Chicago, Ill.; CDL:091015-H)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 H

00056451 Plank, J.; Richter, W.R. (1970) Report to the Quaker Oats Company: Ninety-Day Subacute Oral Toxicity Study of THFA in Albino Rats: IBT No. B8494. (Unpublished study received Feb 7, 1972 under 2F1198; prepared by Industrial Bio-Test Laboratories, Inc., submitted by Quaker Oats Co., Chicago, Ill.; CDL:091015-I)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	02/07/72	2F1198	091015 I

*** END OF OUTPUT ***

Return to PDMS Menu

PDMS Search - Display First Submitter Information

Last Search: Administrative Numbers: 2E1198
Citations Selected: 2

00140107 Quaker Oats Co. (1972) Chemistry: Tetrahydrofurfurly Alcohol . (Compilation; unpublished study received 1972 under 2E1198; CDL: 095920-A)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	01/01/72	2E1198	095920 A

00140108 Quaker Oats Co. (1957) Physiological Data on 00 Tetrahydrofurfuryl Alcohol. (Unpublished study received Sep 20, 1971 under 2E1198; CDL:095920-B)

First Submitter: QUAKER OATS COMPANY

First Submitter No.	Submission Date	Administrative No.	Accession No.
007789	09/20/71	2E1198	095920 B

*** END OF OUTPUT ***

Return to PDMS Menu

APPENDIX VI

Bibliographic Listings of Scientific Literature
(with limited abstracts)

National Library of Medicine - Medical Subject Headings

2001 MeSH

MeSH Supplementary Concept Data

Return to Entry Page

Name of Substance	tetrahydrofurfuryl alcohol
Record Type	C
Registry Number	97-99-4
Related Number	22415-59-4 ((R)-isomer)
Related Number	57203-01-7 ((S)-isomer)
Entry Term	tetrahydrofurfuryl alcohol, (R)-isomer
Entry Term	tetrahydrofurfuryl alcohol, (S)-isomer
Heading Mapped to	*Furans
Previous Indexing	* ALCOHOLS (79-82)
Source	Sud Med Ekspert 22(1):49;1979
Thesaurus ID	Merck, 9th ed, #8931
Frequency	4
Note	RN given refers to parent cpd; structure
Date of Entry	19790101
Revision Date	20000822
Unique ID	C018675

Return to Entry Page

Fact Sheet
Hazardous Substances Data Bank (HSDB®)

HSDB is a toxicology data file on the National Library of Medicine's (NLM) Toxicology Data Network (TOXNET®). It focuses on the toxicology of potentially hazardous chemicals. It is enhanced with information on human exposure, industrial hygiene, emergency handling procedures, environmental fate, regulatory requirements, and related areas. All data are referenced and derived from a core set of books, government documents, technical reports and selected primary journal literature. HSDB is peer-reviewed by the Scientific Review Panel (SRP), a committee of experts in the major subject areas within the data bank's scope. HSDB is organized into individual chemical records, and contains over 4500 such records.

Web Access/Searching

HSDB is accessible, free of charge, via TOXNET at: http://toxnet.nlm.nih.gov

Users can search by chemical or other name, chemical name fragment, Chemical Abstracts Service Registry Number (RN), and/or subject terms. Search results can easily be viewed, printed or downloaded. Search results are displayed in relevancy ranked order. Users may select to display exact term matches, complete records, or any combination of data from the following broad groupings:

Human Health Effects
Emergency Medical Treatment
Animal Toxicity Studies
Metabolism/Pharmacokinetics
Pharmacology
Environmental Fate/Exposure
Chemical/Physical Properties
Chemical Safety & Handling
Occupational Exposure Standards
Manufacturing/Use Information
Laboratory Methods
Special References
Synonyms and Identifiers
Administrative Information

Users can easily conduct their HSDB search strategy against other databases: Chemical Carcinogenesis Research Information System, Integrated Risk Information System, and GENE-TOX.

HSDB Review Status Tags

Associated with each data statement in HSDB is one of the following review status tags indicating the level of quality review: "Peer Reviewed" - representing data which has undergone peer review

by the Scientific Review Panel or other high level review group, "QC Reviewed" - representing data which has received a quality control review, but not yet been reviewed by the Scientific Review Panel, "Unreviewed" - used for a limited number of data statements, such as industry submissions, which do not readily lend themselves to scientific review.

Further Information

For detailed information about HSDB or TOXNET, contact:

HSDB Representative
National Library of Medicine
Specialized Information Services
8600 Rockville Pike
Bethesda, MD 20894
Fax: (301) 480-3537
Telephone: (301) 496-1131
e-mail: tehip@teh.nlm.nih.gov
URL: http://sis.nlm.nih.gov

For information on NLM services, contact:

National Library of Medicine
Customer Service
8600 Rockville Pike
Bethesda, MD 20894
Telephone: 1-888-FINDNLM (1-888-346-3656) or (301) 594-5983
e-mail: custserv@nlm.nih.gov

TETRAHYDROFURFURYL ALCOHOL

CASRN: 97-99-4

For other data, click on the Table of Contents

Human Health Effects:

Human Toxicity Excerpts:

MODERATELY IRRITATING TO SKIN, MUCOUS MEMBRANES.
[Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989. 1452]**PEER REVIEWED**

EFFECTS REPORTED IN ACUTE POISONING WHICH RESULTED IN DEATH WITHIN 2-3 DAYS WERE SWELLING IN THE BRAIN, HEMORRHAGES IN VISCERAL PLEURA & EPICARDIUM, HYPERVOLEMIA OF ORGANS, & EXPANDED LUNG. MUCOSA OF THE UPPER DIGESTIVE TRACT & STOMACH SHOWED SWELLING, HYPERVOLEMIA, HEMORRHAGE, & NECROSIS. IN DEATH OCCURRING AFTER 3 DAYS, LIVER WEIGHT INCREASED & SHOWED YELLOWISH-BROWN CROSS SECTION WITH HEMORRHAGES. HEPATOCYTES WERE NECROTIC & SOME CONTAINED FAT DROPLETS.
[BEREZHNOI RV; SERGEEV SN; SUD MED EKSPERT 22 (1): 49 (1979)]**PEER REVIEWED**

... Irritating to human ... eyes.
[Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986. 894]**PEER REVIEWED**

Skin, Eye and Respiratory Irritations:

... Irritating to human ... eyes.
[Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986. 894]**PEER REVIEWED**

Probable Routes of Human Exposure:

Occupational exposure to tetrahydrofurfuryl alcohol occurs through dermal contact and inhalation of vapor(1).
[(1) Parmeggiani L; Encyl Occup Health & Safety 3rd ed Geneva, Switzerland: International Labour Office p. 931-2 (1983)]**PEER REVIEWED**

NIOSH (NOES Survey 1981-1983) has statistically estimated that 79,915 workers are potentially exposed to tetrahydrofurfuryl alcohol in the USA(1). NIOSH (NOHS Survey 1972-1974) has statistically estimated that 2,169 workers are potentially exposed to tetrahydrofurfuryl alcohol in the USA(2).
[(1) NIOSH; National Occupational Exposure Survey (NOES) (1983) (2) NIOSH; National Occupational Hazard Survey (NOHS) (1974)]**PEER REVIEWED**

UNITED STATES
National Library of Medicine

Fact Sheet

Chemical Carcinogenesis Research Information System (CCRIS®)

CCRIS is a toxicology data file of the National Library of Medicine's (NLM) Toxicology Data Network (TOXNET®). It is a scientifically evaluated and fully referenced data bank, developed and maintained by the National Cancer Institute (NCI). It contains some 8000 chemical records with carcinogenicity, mutagenicity, tumor promotion, and tumor inhibition test results. Data are derived from studies cited in primary journals, current awareness tools, NCI reports, and other special sources. Test results have been reviewed by experts in carcinogenesis and mutagenesis.

Web Access/Searching

CCRIS is accessible, free of charge, via TOXNET at: http://toxnet/nlm.nih.gov

Users can search by chemical or other name, chemical name fragment, Chemical Abstracts Service Registry Number (RN), and/or subject terms. Search results can easily be viewed, printed or downloaded. Search results are displayed in relevancy ranked order. Users may select to display any combination of data from the following broad groupings:

(a) Carcinogenicity Studies
(b) Tumor Promotion Studies
(c) Mutagenicity Studies
(d) Tumor Inhibition Studies

Users can easily conduct their CCRIS search strategy against other databases: Hazardous Substances Data Bank®, Integrated Risk Information System, and GENE-TOX.

Further Information

For detailed information about CCRIS or TOXNET, contact:

CCRIS Representative
Specialized Information Services
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
Telephone (301) 496-6531
FAX: (301) 480-3537
e-mail: toxmail@toxnetmail.nlm.nih.gov
URL: http://sis.nlm.nih.gov

For information on NLM services, contact:

National Library of Medicine
Customer Service
8600 Rockville Pike
Bethesda, MD 20894
Telephone: 1-888-FINDNLM (1-888-346-3656) or (301) 594-5983
e-mail: custserv@nlm.nih.gov

TETRAHYDROFURFURYL ALCOHOL

CASRN: 97-99-4

For other data, click on the Table of Contents

Substance Identification:

Substance Name: TETRAHYDROFURFURYL ALCOHOL

CAS Registry Number: 97-99-4

Data Type:

Mutagenicity

Studies Data:

Mutagenicity Studies:

Test System:	AMES SALMONELLA TYPHIMURIUM
Strain Indicator:	TA98
Metabolic Activation:	NONE
Method:	PREINCUBATION
Dose:	0.01-1000 UMOL/PLATE (TEST MATERIAL SOLVENT: METHANOL)
Results:	NEGATIVE
Reference:	

[AESCHBACHER,HU, WOLLEB,U, LOLIGER,J, SPADONE,JC AND LIARDON,R; CONTRIBUTION OF COFFEE AROMA CONSTITUENTS TO THE MUTAGENICITY OF COFFEE; FOOD CHEM. TOXICOL. 27 (4):227-232, 1989]

Test System:	AMES SALMONELLA TYPHIMURIUM
Strain Indicator:	TA100
Metabolic Activation:	NONE
Method:	PREINCUBATION
Dose:	0.01-1000 UMOL/PLATE (TEST MATERIAL SOLVENT: METHANOL)
Results:	NEGATIVE
Reference:	

[AESCHBACHER,HU, WOLLEB,U, LOLIGER,J, SPADONE,JC AND LIARDON,R; CONTRIBUTION OF COFFEE AROMA CONSTITUENTS TO THE MUTAGENICITY OF COFFEE; FOOD CHEM. TOXICOL. 27 (4):227-232, 1989]

Test System:	AMES SALMONELLA TYPHIMURIUM
Strain Indicator:	TA102
Metabolic Activation:	NONE
Method:	PREINCUBATION
Dose:	0.01-1000 UMOL/PLATE (TEST MATERIAL SOLVENT: METHANOL)
Results:	NEGATIVE
Reference:	

[AESCHBACHER,HU, WOLLEB,U, LOLIGER,J, SPADONE,JC AND LIARDON,R; CONTRIBUTION OF COFFEE AROMA CONSTITUENTS TO THE MUTAGENICITY OF COFFEE; FOOD CHEM. TOXICOL. 27 (4):227-232, 1989]

Test System:	AMES SALMONELLA TYPHIMURIUM
Strain Indicator:	TA98
Metabolic Activation:	RAT, LIVER, S-9, AROCLOR 1254
Method:	PREINCUBATION
Dose:	0.01-1000 UMOL/PLATE (TEST MATERIAL SOLVENT: METHANOL)
Results:	NEGATIVE
Reference:	

[AESCHBACHER,HU, WOLLEB,U, LOLIGER,J, SPADONE,JC AND LIARDON,R; CONTRIBUTION OF COFFEE AROMA CONSTITUENTS TO THE MUTAGENICITY OF COFFEE; FOOD CHEM. TOXICOL. 27 (4):227-232, 1989]

Test System:	AMES SALMONELLA TYPHIMURIUM
Strain Indicator:	TA100
Metabolic Activation:	RAT, LIVER, S-9, AROCLOR 1254
Method:	PREINCUBATION
Dose:	0.01-1000 UMOL/PLATE (TEST MATERIAL SOLVENT: METHANOL)
Results:	NEGATIVE
Reference:	

[AESCHBACHER,HU, WOLLEB,U, LOLIGER,J, SPADONE,JC AND LIARDON,R; CONTRIBUTION OF COFFEE AROMA CONSTITUENTS TO THE MUTAGENICITY OF COFFEE; FOOD CHEM. TOXICOL. 27 (4):227-232, 1989]

Test System:	AMES SALMONELLA TYPHIMURIUM
Strain Indicator:	TA102
Metabolic Activation:	RAT, LIVER, S-9, AROCLOR 1254
Method:	PREINCUBATION
Dose:	0.01-1000 UMOL/PLATE (TEST MATERIAL SOLVENT: METHANOL)
Results:	NEGATIVE
Reference:	

[AESCHBACHER,HU, WOLLEB,U, LOLIGER,J, SPADONE,JC AND LIARDON,R; CONTRIBUTION OF COFFEE AROMA CONSTITUENTS TO THE MUTAGENICITY OF COFFEE; FOOD CHEM. TOXICOL. 27 (4):227-232, 1989]

Administrative Information:

CCRIS Record Number: 2923

Last Revision Date: 19911001

Update History:

Complete Update on 10/01/1991, 4 fields added/edited/deleted.

TOXLINE Search **Item 1 of 29**

FORENSIC MEDICAL DIAGNOSIS OF INTOXICATIONS WITH TETRA HYDRO FURFURYL ALCOHOL MORPHOLOGICAL CHANGES IN THE INTERNAL ORGANS

Authors:

BEREZHNOI RV
SERGEEV SN

Source: SUD-MED EKSPERT; 22 (1). 1979. 49-51.

Abstract:

HEEP COPYRIGHT: BIOL ABS. HUMAN AUTOPSY BRAIN HEART LUNG ESOPHAGUS STOMACH KIDNEY ADRENAL

CAS Registry Numbers:

97-99-4

Language: Russian

Coden:

SMEZA

Entry Month: March, 1981

Year of Publication: 1979

Secondary Source ID: HEEP/81/04231

TOXLINE Search

Thermal Desorptionas Chromatographic/Mass Spectrometric Analysis of Volatile Organic Compounds in the Offices of Smokers and Nonsmokers

Authors:

Bayer CW
Black MS

Source: Biomedical and Environmental Mass Spectrometry, Vol. 14, No. 8, pages 363-367, 26 references, 19871987

Abstract:

Concentrations of volatile organic compounds (VOCs) were determined in indoor air of offices of smokers and nonsmokers in efforts to understand whether environmental tobacco smoke contamination could be distinguished from airborne pollutants outgassing from other sources. Air was sampled onto sorbents using personal sampling pumps, and material was thermally desorbed and analyzed by gas chromatography and mass spectrometry. Common VOCs detected in indoor air included aliphatic hydrocarbons, alkylated aromatic hydrocarbons, chlorinated hydrocarbons, and a few miscellaneous compounds. No patterns emerged which would correlate identified VOCs to the presence of environmental tobacco smoke. In studies of side stream smoke to detect compounds present in smoke and not normally present in indoor air, many compounds detected were nitrogen pyrolysates. Five compounds present in offices occupied by smokers but not commonly found indoors were pyrrolidine (123751), 6-chloro-2H-pyran-2-one, tetrahydrofuranmethanol (97994), 2-methyl-1H-pyrrole (636419), and 2-methylpropyl-cyanate (CAS). Nicotine was not detected by the survey air analysis described, but use of Orbo-42 sorbent tubes and gas chromatography with a nitrogen phosphorous detector revealed higher concentrations of nicotine in office air of smokers compared to nonsmokers. The nicotine level distinguished smokers' offices from those of nonsmokers, with respective ranges of 1.48 to 2.71 and 0.02 to 0.32 parts per billion by volume. While it was not possible to prove beyond doubt that the five unusual VOCs arose from the presence of a tobacco smoker in the office, particularly since they were not detected in every office in which a smoker worked, the authors conclude that these findings warrant additional study.

Keywords:

DCN-162222
Air quality measurement
Office workers
Workplace studies
Smoke inhalation
Smoking
Air sampling
Cigarette smoking
Chemical analysis
Volatiles

CAS Registry Numbers:

123-75-1
123-75-1

97-99-4
636-41-9

Coden:

BMSYAL

Entry Month: March, 1990

Year of Publication: 1987

Secondary Source ID: NIOSH/00174408

TOXLINE Search

Fragrances and other materials in deodorants: Search for potentially sensitizing molecules using combined GC-MS and structure activity relationship (SAR) analysis.

Authors:

RASTOGI SC
LEPOITTEVIN J-P
JOHANSEN JD
FROSCH PJ
MENNE T
BRUZE M
DREIER B
ANDERSEN KE
WHITE IR

Author Address: Natl. Environ. Res. Inst., Dep. Environ. Chem., Frederiksborgvej 399, P.O.B. 358, DK-4000 Roskilde, Denmark.

Source: CONTACT DERMATITIS; 39 (6). 1998. 293-303.

Abstract:

BIOSIS COPYRIGHT: BIOL ABS. Deodorants are one of the most frequently-used types of cosmetics and are a source of allergic contact dermatitis. Therefore, a gas chromatography - mass spectrometric analysis of 71 deodorants was performed for identification of fragrance and non-fragrance materials present in marketed deodorants. Furthermore, the sensitizing potential of these molecules was evaluated using structure activity relationships (SARs) analysis. This was based on the presence of 1 or more chemically reactive site(s), in the chemical structure, associated with sensitizing potential. Among the many different substances used to formulate cosmetic products (over 3500), 226 chemicals were identified in a sample of 71 deodorants. 84 molecules were found to contain at least 1 structural alert, and 70 to belong to, or be susceptible to being metabolized into, the chemical group of aldehydes, ketones and alpha,beta-unsaturated aldehydes, ketone or esters. The combination of GC-MS and SARs analysis co

Medical Subject Headings (MeSH):

BIOCHEMISTRY/METHODS
BIOCHEMISTRY
HYPERSENSITIVITY

Keywords:

Biochemical Methods-General
Biochemical Studies-General
Allergy

CAS Registry Numbers:

84-69-5

84-69-5
150-86-7
138-86-3
127-91-3
119-61-9
99-83-2
106-61-6
111-70-6
117-81-7
85-91-6
5471-51-2
118-61-6
119-36-8
5392-40-5
100-52-7
108-39-4
101-81-5
134-20-3
99-87-6
470-82-6
93-15-2
93-16-3
84-66-2
131-70-4
60-12-8
535-77-3
80-56-8
103-45-7
87-20-7
78-79-5
13019-22-2
104-93-8
76-22-2
110-27-0
1490-04-6
529-20-4
25167-81-1
563-83-7
1125-12-8
520-45-6
142-50-7
128-37-0
122-99-6
122-39-4
120-72-9
112-27-6
111-90-0
110-63-4
110-44-1
109-86-4
108-95-2
108-46-3
106-49-0
106-28-5
105-60-2
99-76-3
98-86-2

98-55-5
98-54-4
97-99-4
95-48-7
93-58-3
85-44-9
77-93-0
69-72-7
67-63-0
65-85-0
56-81-5

Language: English

Coden:

CODED

Entry Month: May, 1999

Year of Publication: 1998

Secondary Source ID: BIOSIS/99/04901

TOXLINE Search **Item 14 of 29**

Degradation of tetrahydrofurfuryl alcohol by Ralstonia eutropha is initiated by an inducible pyrroloquinoline quinone-dependent alcohol dehydrogenase.

Authors:

ZARNT G
SCHRAEDER T
ANDREESEN JR

Author Address: Institut fuer Mikrobiologie, Universitaet Halle, Kurt-Mothes-Str. 3, D-06099 Halle, Germany.

Source: APPLIED AND ENVIRONMENTAL MICROBIOLOGY; 63 (12). 1997. 4891-4898.

Abstract:

BIOSIS COPYRIGHT: BIOL ABS. An organism tentatively identified as Ralstonia eutropha was isolated from enrichment cultures containing tetrahydrofurfuryl alcohol (THFA) as the sole source of carbon and energy. The strain was able to tolerate up to 200 mM THFA in mineral salt medium. The degradation was initiated by an inducible ferricyanide-dependent alcohol dehydrogenase (ADH) which was detected in the soluble fraction of cell extracts. The enzyme catalyzed the oxidation of THFA to the corresponding tetrahydrofuran-2-carboxylic acid. Studies with n-pentanol as the substrate revealed that the corresponding aldehyde was released as a free intermediate. The enzyme was purified 211-fold to apparent homogeneity and could be identified as a quinohemoprotein containing one pyrroloquinoline quinone and one covalently bound heme c per monomer. It was a monomer of 73 kDa and had an isoelectric point of 9.1. A broad substrate spectrum was obtained for the enzyme, which converted different primary alcohols,

Medical Subject Headings (MeSH):

BIOCHEMISTRY
COMPARATIVE STUDY
BIOCHEMISTRY/METHODS
BIOCHEMISTRY
NUCLEIC ACIDS
PURINES
PYRIMIDINES
AMINO ACIDS
PEPTIDES
PROTEINS
COENZYMES
COMPARATIVE STUDY
ENZYMES
ENZYMES/PHYSIOLOGY
METABOLISM
NUTRITION
NUTRITIONAL STATUS
POISONING
ANIMALS, LABORATORY
BACTERIA/PHYSIOLOGY

BACTERIA/METABOLISM
SANITATION
SEWAGE
AIR POLLUTION
SOIL POLLUTANTS
WATER POLLUTION
BIODEGRADATION
INDUSTRIAL MICROBIOLOGY
GRAM-NEGATIVE AEROBIC BACTERIA

Keywords:

Comparative Biochemistry
Biochemical Methods-General
Biochemical Studies-General
Biochemical Studies-Nucleic Acids
Biochemical Studies-Proteins
Enzymes-General and Comparative Studies
Enzymes-Physiological Studies
Metabolism-General Metabolism
Nutrition-General Studies
Toxicology-General
Physiology and Biochemistry of Bacteria
Public Health: Environmental Health-Sewage Disposal and Sanitary Measures
Public Health: Environmental Health-Air
Food and Industrial Microbiology-Biodegradation and Biodeterioration
Gram-Negative Aerobic Rods and Cocci (1992-)

CAS Registry Numbers:

106-51-4
106-51-4
97-99-4
88-14-2
71-41-0

Language: English

Coden:

AEMID

Entry Month: May, 1998

Year of Publication: 1997

Secondary Source ID: BIOSIS/98/02930

TOXLINE Search **Item 16 of 29**

GENOTOXICITY OF INDUSTRIAL SOLVENTS.

Authors:

RODOLFO C
ORNELLA F
CRISTINA P
ROMANA P

Author Address: ASSOCIATION OF PHARMACEUTICAL INDUSTRY (AFI) MUTAGENESIS STUDY GROUP, MILAN, ITALY.

Source: MUTAT RES 1992 APR;271(2):179

Abstract:

THE GENOTOXIC HAZARDS OF SOLVENTS HAVE BEEN INVESTIGATED BY THE MUTAGENESIS STUDY GROUP OF THE ASSOCIATION OF PHARMACEUTICAL INDUSTRY (AFI) IN ORDER TO EVALUATE IF THESE AGENTS PRODUCE ALTERATIONS IN THE NUCLEIC ACIDS AT SUBTOXIC EXPOSURE LEVELS RESULTING IN DNA DAMAGE OR MUTATIONS. A NUMBER OF SOLVENTS, COMMONLY USED IN THE PHARMACEUTICAL INDUSTRY AND REPRESENTATIVE OF DIFFERENT CLASSES OF CHEMICALS, WERE CONSIDERED: ALCOHOLS (METHANOL, ETHANOL, N-BUTANOL, ISOBUTANOL, ISOPROPANOL); ALKANES (HEXANE, N-HEPTANE); ESTERS (ETHYL ACETATE, ETHYL ACETOACETATE); KETONES (ACETONE, 2-BUTANONE, CYCLOHEXANONE, 4-METHYL-2-PENTANONE); HYDROCARBONS (CYCLOHEXANE, BENZENE, CHLOROBENZENE, TOLUENE, XYLENE); AMIDES (N,N-DIMETHYLFORMAMIDE, FORMAMIDE, DIMETHYLACETAMIDE, TRIETHYLAMINE); NITRILES (ACETONITRILE); ETHERS (P-DIOXANE, PETROLEUM ETHER, TETRAHYDROFURAN); HALOGENATED HYDROCARBONS (TRICHLORO-ETHYLENE, CHLOROFORM, DICHLOROMETHANE, 1,2-DICHLOROETHANE, CARBON TETRACHLORIDE); HYDROXYETHERS (GLYCEROL FORMAL, TETRAHYDROFURFURYL ALCOHOL); GLYCOLS (ETHYLENE GLYCOL, PROPYLENE GLYCOL); OTHERS (PYRIDINE, ACETIC ACID). THE GENETIC ENDPOINTS TAKEN INTO ACCOUNT WERE GENE MUTATION, CHROMOSOME ABERRATIONS, AND DNA REPAIR. MOST INFORMATION REPORTED HERE WAS DRAWN FROM REFERENCE DATA. AS REFERENCE DATA WERE NOT AVAILABLE FOR ALL SOLVENTS, ATTEMPTS WERE MADE TO COMPLETE EXPERIMENTALLY THE EXISTING INFORMATION. A NUMBER OF TRIALS WERE CARRIED OUT EMPLOYING THE FOLLOWING TESTS SYSTEMS: GENE MUTATION IN SALMONELLA AND ESCHERICHIA COLI BACTERIAL STRAINS AND V79 MAMMALIAN CELLS; CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTES IN VITRO AND DNA REPAIR IN RAT HEPATOCYTE PRIMARY CULTURES AND SACCHAROMYCES CEREVISIAE.

Taxonomic Name:

SALMONELLA TYPHIMURIUM
ESCHERICHIA COLI
CRICETULUS GRISEUS

HOMO SAPIENS
SACCHAROMYCES CEREVISIAE
RATTUS

Test Object: BACTERIA
MAMMAL,CHINESE HAMSTER CELL CULTURE
MAMMAL,HUMAN CELL CULTURE
FUNGUS,YEAST
MAMMAL,RAT CELL CULTURE

Tissue Cultured:

V79 CELLS
LYMPHOCYTES
HEPATOCYTES

Cells Observed:

SOMATIC CELLS

Assay:

Test Category: GENE MUTATIONS
Specific Test/Endpoint: AMES TEST

Test Category: EFFECTS ON CHROMOSOMES
Specific Test/Endpoint: CHROMOSOME ABERRATIONS

Test Category: EFFECTS ON NUCLEIC ACIDS
Specific Test/Endpoint: DNA REPAIR

Substance (CAS Registry Number):

METHANOL (67-56-1)
ETHANOL (64-17-5)
BUTANOL (71-36-3)
ISOBUTANOL (78-83-1)
ISOPROPANOL (67-63-0)
HEXANE (110-54-3)
HEPTANE (142-82-5)
ETHYL ACETATE (141-78-6)
ETHYL ACETOACETATE (141-97-9)
ACETONE (67-64-1)
2-BUTANONE (78-93-3)
CYCLOHEXANONE (108-94-1)
4-METHYL-2-PENTANONE (108-10-1)
CYCLOHEXANE (110-82-7)
BENZENE (71-43-2)
CHLOROBENZENE (108-90-7)
TOLUENE (108-88-3)
XYLENE (1330-20-7)
N,N-DIMETHYLFORMAMIDE (68-12-2)
FORMAMIDE (75-12-7)
DIMETHYLACETAMIDE (127-19-5)

TRIETHYLAMINE (121-44-8)
ACETONITRILE (75-05-8)
P-DIOXANE (123-91-1)
PETROLEUM ETHER (8030-30-6)
TETRAHYDROFURAN (109-99-9)
TRICHLOROETHYLENE (79-01-6)
CHLOROFORM (67-66-3)
DICHLOROMETHANE (75-09-2)
1,2-DICHLOROETHANE (107-06-2)
CARBON TETRACHLORIDE (56-23-5)
GLYCEROL FORMAL (5464-28-8)
TETRAHYDROFURFURYL ALCOHOL (97-99-4)
ETHYLENE GLYCOL (107-21-1)
PROPYLENE GLYCOL (57-55-6)
PYRIDINE (110-86-1)
ACETIC ACID (64-19-7)

Language: English

International Standard Serial Number: 0165-7992

Publication Types:

ABSTRACT
REVIEW
ORIGINAL DATA

Entry Month: November, 1992

Journal Title Code: MUREA

Title Abbreviation: MUTAT RES

Year of Publication: 1992

Secondary Source ID: EMIC/MUT/92000925
EMIC/87458

Last Revision Date: March 30, 1993

TOXLINE Search **Item 20 of 29**

FOLLOW-UP INFORMATION: TETRAHYDROFURFURYL ALCOHOL DERMAL SENSITISATION STUDY (FINAL REPORT) WITH COVER LETTER DATED 072291 (SANITIZED)

Corporate Name: LIFE SCIENCE RESEARCH LAB

Source: EPA/OTS; Doc #89-910000226

Keywords:

CONFIDENTIAL
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
PRIMARY DERMAL SENSITIZATION
MAMMALS
GUINEA PIGS
DERMAL

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0529903-1

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 07/26/91

Year of Publication: 1991

Secondary Source ID: TSCATS/421061

TOXLINE Search **Item 21 of 29**

INITIAL SUBMISSION: LETTER SUBMITTING RESULTS FROM TWO SUBACUTE ORAL TOXICITY STUDIES AND ONE TESTICULAR MATURATION STUDY ON TETRAHYDROFURFURYL ALCOHOL

Source: EPA/OTS; Doc #88-920000028

Keywords:

GREAT LAKES CHEM CORP
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
SUBCHRONIC TOXICITY
MAMMALS
RATS
ORAL
DIET
DOGS
REPRODUCTION/FERTILITY EFFECTS

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0535211

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 10/24/91

Year of Publication: 1991

Secondary Source ID: TSCATS/422183

TOXLINE Search **Item 22 of 29**

INITIAL SUBMISSION: ACUTE DERMAL TOXICITY TEST IN RABBITS WITH PH 422-BL-001-82 (FINAL REPORT) WITH ATTACHMENTS AND COVER LETTER DATED 022192

Corporate Name: PHARMAKON RES INTL INC

Source: EPA/OTS; Doc #88-920001191

Keywords:

AT&T
PH 422-BL-001-82
HEALTH EFFECTS
ACUTE TOXICITY
MAMMALS
RABBITS
DERMAL

CAS Registry Numbers:

97-99-4
98-00-0

Order Number: NTIS/OTS0537088

Entry Month: January, 2001

Classification Code: TSCA Sect. 8ECP Rec 02/28/92

Year of Publication: 1992

Secondary Source ID: TSCATS/423090

TOXLINE Search **Item 22 of 29**

INITIAL SUBMISSION: ACUTE DERMAL TOXICITY TEST IN RABBITS WITH PH 422-BL-001-82 (FINAL REPORT) WITH ATTACHMENTS AND COVER LETTER DATED 022192

Corporate Name: PHARMAKON RES INTL INC

Source: EPA/OTS; Doc #88-920001191

Keywords:

AT&T
PH 422-BL-001-82
HEALTH EFFECTS
ACUTE TOXICITY
MAMMALS
RABBITS
DERMAL

CAS Registry Numbers:

97-99-4
98-00-0

Order Number: NTIS/OTS0537088

Entry Month: January, 2001

Classification Code: TSCA Sect. 8ECP Rec 02/28/92

Year of Publication: 1992

Secondary Source ID: TSCATS/423090

TOXLINE Search **Item 23 of 29**

INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CO TO USEPA REGARDING A DEVELOPMENTAL TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL DATED 101492 (SANITIZED)

Source: EPA/OTS; Doc #88-930000058S

Keywords:

GREAT LAKES CHEM CO
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
REPRODUCTION/FERTILITY EFFECTS
MAMMALS
RATS
ORAL
GAVAGE

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0538320

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 10/29/92

Year of Publication: 1992

Secondary Source ID: TSCATS/424360

TOXLINE Search **Item 23 of 29**

INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CO TO USEPA REGARDING A DEVELOPMENTAL TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL DATED 101492 (SANITIZED)

Source: EPA/OTS; Doc #88-930000058S

Keywords:

GREAT LAKES CHEM CO
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
REPRODUCTION/FERTILITY EFFECTS
MAMMALS
RATS
ORAL
GAVAGE

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0538320

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 10/29/92

Year of Publication: 1992

Secondary Source ID: TSCATS/424360

TOXLINE Search **Item 24 of 29**

SUPPLEMENT: FOLLOW UP LETTER FROM GREAT LAKES CHEM CORP CONCERNING A 13-WEEK DIETARY TOXICITY STUDY WITH TETRAHYDROFURFURYL ALCOHOL IN RATS

Source: EPA/OTS; Doc #89-920000272

Keywords:

GREAT LAKES CHEM CORP
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
SUBCHRONIC TOXICITY
MAMMALS
RATS
ORAL
DIET

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0535211-1

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 06/16/92

Year of Publication: 1992

Secondary Source ID: TSCATS/427314

TOXLINE Search **Item 25 of 29**

SUPPORT INFORMATION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA SUBMITTING INFORMATION CONCERNING A FIVE-DAY ORAL TOXICITY STUDY IN FEMALE RABBITS WITH TETRAHYDROFURFURYL ALCOHOL

Source: EPA/OTS; Doc #89-920000346

Keywords:

GREAT LAKES CHEM CORP
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
SUBCHRONIC TOXICITY
MAMMALS
RABBITS
ORAL
GAVAGE

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0535211-2

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 09/03/92

Year of Publication: 1992

Secondary Source ID: TSCATS/431157

TOXLINE Search Item 26 of 29

INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA REGARDING 90-DAY DERMAL AND INHALATION TOXICITY STUDIES OF TETRAHYDROFURFURYL ALCOHOL IN RATS DATED 010495

Source: EPA/OTS; Doc #88-950000099

Keywords:

GREAT LAKES CHEM CORP
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
SUBCHRONIC TOXICITY
MAMMALS
RATS
DERMAL
INHALATION
NEUROTOXICITY

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0556424

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 01/18/95

Year of Publication: 1995

Secondary Source ID: TSCATS/441619

TOXLINE Search Item 27 of 29

INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA SUBMITTING RESULTS IN 90-DAY INHALATION TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL, DATED 08/31/95

Corporate Name: WIL RESEARCH LABORATORIES INC

Source: EPA/OTS; Doc #88-950000288

Keywords:

GREAT LAKES CHEM CORP
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
SUBCHRONIC TOXICITY
MAMMALS
RATS
INHALATION

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0557931

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 09/06/95

Year of Publication: 1995

Secondary Source ID: TSCATS/443450

TOXLINE Search **Item 28 of 29**

INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA REPORTING RESULTS FROM A 90-DAY DERMAL TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL, DATED 08/30/95

Corporate Name: WIL RESEARCH LABORATORIES INC

Source: EPA/OTS; Doc #88-950000289

Keywords:

GREAT LAKES CHEM CORP
TETRAHYDROFURFURYL ALCOHOL
HEALTH EFFECTS
SUBCHRONIC TOXICITY
MAMMALS
RATS
DERMAL

CAS Registry Numbers:

97-99-4

Order Number: NTIS/OTS0557932

Entry Month: January, 2001

Classification Code: TSCA Sect. 8E Rec 09/06/95

Year of Publication: 1995

Secondary Source ID: TSCATS/443451

TOXLINE Search

Item 29 of 29

Evaluation of ocular irritation in the rabbit: Objective versus subjective assessment.

Authors:

CONQUET P
DURAND G
LAILLIER J
PLAZONNET B

Author Address: MSD Chibret Res. Inst., 63018 Clermont Ferrand Cedex, Fr.

Source: TOXICOL APPL PHARMACOL; 39 (1). 1977 129-139

Abstract:

HEEP COPYRIGHT: BIOL ABS. There are several methods for assessing ocular irritation in laboratory animals. The most common method is that of Draize, but an objective evaluation of tissue changes, such as corneal and conjunctival edema, and conjunctival and ciliary body capillary disruption may also be used. The present investigation compares the subjective Draize score to several objective procedures, i.e., corneal thickness measurement, evaluation of corneal and conjunctival water content and conjunctival and aqueous humor concentrations of a dye bound to plasma proteins after i.v. injection. The following 7 organic solvents were tested: tetrahydrofurfuryl alcohol, N-methylformamide, Solketal, Carbitol, dimethyl sulfoxide, propylene glycol and triacetin. After a single instillation of 100 mul of undiluted compound in the rabbit eye, evaluation of the above parameters was made at 2 and 24 h. Draize score and corneal thickness were further determined daily for 10 additional days. A linear correlation was found between Draize total score and tissue changes. This was due mainly to the highly significant correlation between conjunctival Draize score and conjunctival edema and capillary permeability. There was a significant correlation between Draize corneal score and corneal edema or thickness only on day 1. No relationships were shown between iris hyperemia and Evans blue dye diffusion into the aqueous humor following i.v. injection. Minor corneal damage was difficult to assess with the Draize system, and corneal thickness determination appeared to be helpful to this purpose. In addition to the standard Draize method, corneal thickness measurements should be performed. Both subjective and objective procedures ranked the compounds' irritant potential in the same order.

CAS Registry Numbers:

123-39-7
123-39-7
111-90-0
102-76-1
100-79-8
97-99-4
67-68-5
57-55-6

Coden:

TXAPA

Entry Month: December, 1977

Year of Publication: 1977

Secondary Source ID: HEEP/77/10180

Answer Page

Results for Search Question:
RN: 97-99-4

0 answers in ADISINSIGHT database
36 answers in CAplus (Toxicology focus) database
1 answers in HSDB database
1 answers in RTECS database
30 answers in TOXLINE database
68 total hits
[Hide Database Info.]

✓ = Abstract and/or article obtained and reviewed.

Too many answers? Refine Search | Show Duplicates

Clear	**Titles from CAplus (Toxicology focus) database in Most Recent Order** | Best Match Order
☐ 1	Preparation of pyrazinyl phenoxyethyl ethers as 5-HT2C receptor modulators [$3.85]
☐ 2	Diisopropylbenzene-containing solvent and method of developing flexographic printing plates [$3.85]
☑ 3	**Toxicity** tests in cell cultures for the purpose of predicting acute **toxicity** (LD50) and reducing the number of animal experiments [$3.85]
☑ 4	Comparison of in vivo and in vitro **toxicity** tests from co-inertia analysis [$3.85]
☐ 5	Evaluation of the bovine corneal opacity-permeability assay as an in vitro alternative to the Draize eye irritation test [$3.85]
☑ 6	Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents [$3.85]
☐ 7	Antimicrobial compositions containing propylene carbonate and/or ethylene carbonate as the carrier solvent [$3.85]
☐ 8	Bovine corneal opacity and permeability test: an in vitro assay of ocular irritancy [$3.85]
☐ 9	Correlation and validation of alternative methods to the Draize eye irritation test (OPAL project) [$3.85]
☐ 10	The luminescent bacteria **toxicity** test: its potential as an in vitro alternative [$3.85]
☐ 11	Cytotoxicity testing of 114 compounds by the determination of the protein content in Hep G2 cell cultures [$3.85]
☑ 12	An objective method for the evaluation of eye irritation in vivo [$3.85]
☐ 13	Topical application of penetration enhancers to the skin of nude mice: a histopathological study [$3.85]
☐ 14	Evaluation of the in vitro uridine uptake inhibition assay in comparison with the in vivo eye irritation test as prescribed by the EEC [$3.85]
☐ 15	Validation of the uridine uptake inhibition assay in cultured human hepatoma cells [$3.85]
☐ 16	Sources of atmospheric emissions of **toxic** substances from furfural-[xylose]-yeast plants [$3.85]
☑ 17	**Toxicity** of agrochemicals to freshwater organism. CIII. Solvents [$3.85]
☐ 18	Inhibition of uridine uptake in cultured cells: a rapid, sublethal cytotoxicity test [$3.85]
☑ 19	**Toxicity** monitored with a correlated set of cell culture assays [$3.85]
☐ 20	**Toxicity** monitored with a correlated set of cell-culture assays [$3.85]
☐ 21	In vitro cytotoxicity assays. Potential alternatives to the Draize ocular allergy test [$3.85]
☐ 22	Alternative approaches to the Draize assay: chemotaxis, cytology, differentiation, and membrane transport studies [$3.85]

23	Uridine uptake inhibition as a cytotoxicity test: correlations with the Draize test [$3.85]
24	Inorganic ion exchanger based on titanium compounds and its use on radioactive wastewaters [$3.85]
25	A solvent effect on the mutagenicity of tryptophan-pyrolyzate mutagens in the Salmonella/mammalian microsome assay [$3.85]
26	Polymer-silicate putty for brickwork [$3.85]
27	Esters of 1-(p-chlorobenzoyl)-5-methoxy-2-methyl-3-indolylacetic acid [$3.85]
28	Compatibility of organic solvents with the Salmonella/microsome test [$3.85]
29	Methods of studying the allergic activity of some chemicals in relation to their standardization in reservoir water [$3.85]
30	Solvents for use in topical applications of insecticides [$3.85]
31	Medicolegal diagnosis of tetrahydrofurfuryl alcohol poisonings. (Morphological changes in internal organs) [$3.85]
32	Anticancer compositions [$3.85]
33	Anticancer preparation [$3.85]
34	Evaluation of ocular irritation in the rabbit. Objective versus subjective assessment [$3.85]
35	Survival of fish in 164 herbicides, insecticides, fungicides, wetting agents, and miscellaneous substances [$3.85]
36	Data for hygienic substantiation of standard levels of tetrahydrofurfuryl alcohol in waters [$3.85]

	Chemical Names from HSDB database in Most Recent Order	**Molecular Formulas**
37	TETRAHYDROFURFURYL ALCOHOL Synonyms (CN):2-FURANMETHANOL, TETRAHYDRO- **PEER REVIEWED**; FURFURYL ALCOHOL, TETRAHYDRO- **PEER REVIEWED**; QO THFA **PEER REVIEWED**; TETRAHYDRO-2-FURANCARBINOL **PEER REVIEWED**; TETRAHYDRO-2-FURANMETHANOL **PEER REVIEWED**; TETRAHYDRO-2-FURANYLMETHANOL **PEER REVIEWED**; TETRAHYDROFURYLALKOHOL (CZECH) **PEER REVIEWED**; TETRAHYDROFURYL CARBINOL **PEER REVIEWED**; TETRAHYDRO-2-FURYLMETHANOL **PEER REVIEWED**; THFA **PEER REVIEWED** STCC No. (CN):49 131 77 Tetrahydrofurfuryl alcohol [$5.65]	C5 H10 O2 **PEER REVIEWED**
	Chemical Names from RTECS database in Most Recent Order	**Molecular Formulas**
38	2-Furanmethanol, tetrahydro-; Furfuryl alcohol, tetrahydro-; QO Thfa; Tetrahydro-2-furancarbinol; Tetrahydro-2-furanmethanol; Tetrahydrofurfuryl alcohol; Tetrahydrofurylalkohol (Czech); Tetrahydrofurfurylalkohol (Czech); Tetrahydro-2-furylmethanol; THFA [$4.70]	C5 H10 O2
	Titles from TOXLINE database in Most Recent Order | Best Match Order	
39	PREDICTING SURFACE TENSION OF LIQUID ORGANIC SOLVENTS. [$1.65]	
40	Organic solvents and surfactants for toxicity test using aquatic organisms and their acceptable concentrations. [$1.65]	
41	Detection by ozone-induced chemiluminescence in chromatography. [$1.65]	
42	Fragrances and other materials in deodorants: Search for potentially sensitizing molecules using combined GC-MS and structure activity relationship (SAR) analysis. [$1.65]	
43	INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA REPORTING RESULTS FROM A 90-DAY DERMAL TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL, DATED 08/30/95. [$1.65]	
44	INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA SUBMITTING RESULTS IN 90-DAY INHALATION TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL, DATED 08/31/95. [$1.65]	
45	INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA REGARDING 90-DAY DERMAL AND INHALATION TOXICITY STUDIES OF TETRAHYDROFURFURYL ALCOHOL IN RATS DATED 010495. [$1.65]	

☑ 46	SUPPLEMENT: FOLLOW UP LETTER FROM GREAT LAKES CHEM CORP CONCERNING A 13-WEEK DIETARY TOXICITY STUDY WITH TETRAHYDROFURFURYL ALCOHOL IN RATS. [$1.65]
☑ 47	INITIAL SUBMISSION: ACUTE DERMAL TOXICITY TEST IN RABBITS WITH PH 422-BL-001-82 (FINAL REPORT) WITH ATTACHMENTS AND COVER LETTER DATED 022192. [$1.65]
☑ 48	INITIAL SUBMISSION: LETTER FROM GREAT LAKES CHEM CO TO USEPA REGARDING A DEVELOPMENTAL TOXICITY STUDY IN RATS WITH TETRAHYDROFURFURYL ALCOHOL DATED 101492 (SANITIZED). [$1.65]
☑ 49	SUPPORT INFORMATION: LETTER FROM GREAT LAKES CHEM CORP TO USEPA SUBMITTING INFORMATION CONCERNING A FIVE-DAY ORAL TOXICITY STUDY IN FEMALE RABBITS WITH TETRAHYDROFURFURYL ALCOHOL. [$1.65]
☑ 50	FOLLOW-UP INFORMATION: TETRAHYDROFURFURYL ALCOHOL DERMAL SENSITISATION STUDY (FINAL REPORT) WITH COVER LETTER DATED 072291 (SANITIZED). [$1.65]

[Page 1] [2] [Next]

Display Selection [Selected on all pages] Display Format [Standard] Display Style [STNEasy]

Display Answers

Results for Search Question:
RN: 97-99-4

Answer Page

0 answers in ADISINSIGHT database
36 answers in CAplus (Toxicology focus) database
1 answers in HSDB database
1 answers in RTECS database
30 answers in TOXLINE database
68 total hits
[Hide Database Info.]

Too many answers? [redacted] Show Duplicates

Clear	Titles from TOXLINE database in **Most Recent Order** | Best Match Order
☑ 51	INITIAL SUBMISSION: LETTER SUBMITTING RESULTS FROM TWO SUBACUTE ORAL TOXICITY STUDIES AND ONE TESTICULAR MATURATION STUDY ON TETRAHYDROFURFURYL ALCOHOL. [$1.65]
☑ 52	Tetrahydrofurfuryl alcohol. [$1.65]
☑ 53	Degradation of tetranydrofurfuryl alcohol by Ralstonia eutropha is initiated by an inducible pyrroloquinoline quinone-dependent alcohol dehydrogenase. [$1.65]
☐ 54	BIODEGRADATION OF TWO CYCLIC ETHERS BY NEWLY ISOLATED BACTERIAL CULTURES. [$1.65]
☐ 55	A QSAR-based biodegradability model: A QSBR. [$1.65]
☐ 56	A SOLVENT EFFECT ON THE MUTAGENICITY OF TRYPTOPHAN-PYROLYSATE MUTAGENS IN THE SALMONELLA/MAMMALIAN MICROSOME ASSAY. [$1.65]
☐ 57	COMPATIBILITY OF ORGANIC SOLVENTS WITH THE SALMONELLA/MICROSOME TEST. [$1.65]
☐ 58	CYTOTOXICITY TESTING OF 114 COMPOUNDS BY THE DETERMINATION OF THE PROTEIN CONTENT IN HEP G2 CELL CULTURES. [$1.65]
☐ 59	VOLATILE COMPOUNDS IN PYROLIGNEOUS LIQUIDS FROM KARAMATSU AND CHISHIMA-SASA. [$1.65]
☐ 60	ANALYSIS OF CYCLOPENTAFUSED ISOMERS OF BENZ-A-ANTHRACENE IN WOOD SMOKE. [$1.65]
☐ 61	INTERNATIONAL CONFERENCE ON PRACTICAL IN-VITRO TOXICOLOGY BERKSHIRE ENGLAND UK SEPTEMBER 18-20 1985. [$1.65]
☐ 62	Sampling of gaseous pollutants on silica gel with 1400 milligram tubes. [$1.65]
☐ 63	TOXICITY MONITORED WITH A CORRELATED SET OF CELL-CULTURE ASSAYS. [$1.65]
☐ 64	A BATTERY OF POTENTIAL ALTERNATIVES TO THE DRAIZE TEST URIDINE UPTAKE INHIBITION MORPHOLOGICAL CYTOTOXICITY MACROPHAGE CHEMOTAXIS AND EXFOLIATIVE CYTOLOGY. [$1.65]
☑ 65	Acute poisoning with tetranydrofurfuryl alcohol combined with methanol. [$1.65]
☐ 66	Poisoning with liquid THF-M. [$1.65]
☑ 67	FORENSIC MEDICAL DIAGNOSIS OF INTOXICATIONS WITH TETRA HYDRO FURFURYL ALCOHOL MORPHOLOGICAL CHANGES IN THE INTERNAL ORGANS. [$1.65]
☐ 68	Evaluation of ocular irritation in the rabbit: Objective versus subjective assessment. [$1.65]

[Prev] [1] [Page 2]

Display Selection [Selected on all pages] Display Format [Standard] Display Style [STNEasy]

BERGESON & CAMPBELL, P.C.
1203 Nineteenth Street, NW | Suite 300 | Washington, DC | 20036-2401 | tel 202.962.8585 | fax 202.962.8599 | web www.lawbc.com

MEMORANDUM

Via Federal Express

DATE: December 6, 2001

TO: Mr. Darryl Brock
Amvac Chemical Corporation

FROM: Allison J. MacDougall ajm
Legal Assistant

RE: Tetrahydrofurfuryl Alcohol Research

Following up on the tetrahydrofurfuryl alcohol (THFA) (CAS No. 97-99-4) research I have been doing at your direction, appended are the following submissions made to EPA by the Great Lakes Chemical Corporation. These submissions were listed on the STN printout I provided to you on October 26, 2001, as item numbers 43 through 51.

- Item No. 43 -- Initial Submission: Letter from Great Lakes Chem Corp to USEPA Reporting Results from a 90-Day Dermal Toxicity Study in Rats with Tetrahydrofurfuryl Alcohol, Dated 08/30/95

- Item No. 44 -- Initial Submission: Letter from Great Lakes Chem Corp to USEPA Submitting Results in 90-Day Inhalation Toxicity Study in Rats with Tetrahydrofurfuryl Alcohol, Dated 08/31/95

- Item No. 45 -- Initial Submission: Letter from Great Lakes Chem Corp to USEPA Regarding 90-Day Dermal and Inhalation Toxicity Studies of Tetrahydrofurfuryl Alcohol in Rats, Dated 01/04/95

- Item No. 46 -- Supplement: Follow Up Letter from Great Lakes Chem Corp Concerning a 13-Week Dietary Toxicity Study with Tetrahydrofurfuryl Alcohol in Rats

affiliated counsel | Bergeson Eliopoulos, LLP | 55 Almaden Boulevard | Suite 400 | San Jose, CA | 95113-2225
affiliated counsel | Bergeson Eliopoulos, LLP | 55 Almaden Boulevard | Suite 400 | San Jose, CA | 95113-2225

- Item No. 48 -- Initial Submission: Letter from Great Lakes Chem Corp to USEPA Regarding a Developmental Toxicity Study in Rats with Tetrahydrofurfuryl Alcohol, Dated 10/14/92

- Item No. 49 – Support Information: Letter from Great Lakes Chem Corp to USEPA Submitting Information Concerning a Five-Day Oral Toxicity Study in Female Rabbits with Tetrahydrofurfuryl Alcohol

- Item No. 50 -- Initial Submission: Letter Submitting Results from Two Subacute Oral Toxicity Studies and One Testicular Maturation Study on Tetrahydrofurfuryl Alcohol

I was unable to obtain the following documents. Please let me know if you would like me to submit a Freedom of Information Act request for these documents.

- Item No. 47 -- Initial Submission: Acute Dermal Toxicity Test in Rabbits with PH 422-BL-001-82 (Final Report) with Attachments and Cover Letter, Dated 02/21/92

- Item No. 50 -- Follow-up Information: Tetrahydrofurfuryl Alcohol Dermal Sensitization Study (Final Report) with Cover Letter, Dated 07/22/91 (Sanitized)

* * * * *

I look forward to your thoughts on how you wish to proceed regarding the two documents I was unable to obtain. As always, please call if you have any questions.

Attachments
cc: Lynn L. Bergeson (w/o attachments)
Lisa M. Campbell (w/o attachments)

Brock, Darryl

From: JEB@NERAC.COM
Sent: Wednesday, October 31, 2001 12:42 PM
To: darrylb@amvac-chemical.com

I used this strategy; it always can be expanded to terms such as ecotoxicity, tumorigens, cancer, etc.

For: JEB (10-31-01)
PROFILE# 1145942 Contact# 104921.00 JEB Date: 10-31-2001

Profile Title: PROFILE FOR MR. DARRYL BROCK

Profile Recipients: Mr. Darryl Brock
Regulatory Manager
American Vanguard Corporation
Suite 1250
4695 MacArthur Court
Newport Beach, CA 92660

Topic Title: DEMO: 97-99-4 TOXICITY

Topic 001 JEB Date: 10-31-2001

Strategy 01 JEB Date: 10-31-2001 Hit Limit: 025 Copies: 001

	T	F	TERM
001	09	01	THFA\AL\VT
002	08	01	97-99-4\RF\RN
003	07	01	TETRAHYDRO-2-FURYLMETHANOL\AL
004	06	01	TETRAHYDRO-2-FURYLMETHANOL\VT
005	05	01	TETRAHYDRO-2-FURANMETHANOL\AL
006	04	01	TETRAHYDRO-2-FURANMETHANOL\VT
007	03	01	TETRAHYDROFURYL-ALCOHOL\AL\VT
008	02	01	TETRAHYDROFURYLALCOHOL\AL\VT
009	01	98	TETRAHYDROFURYL<1N>ALCOHOL\AL\VT
010	99	01	TOXIC\TI\DE\AB\VT
011	99	01	TOXICITY\TI\DE\AB\VT
012	99	01	TOXICOLOGY\TI\DE\AB\VT
013	99	01	TOXICOLOGICAL\TI\DE\AB\VT
014	99	01	SAFETY\TI\DE\AB\VT
015	99	98	ADVERSE\TI\DE\AB\VT

nerac.com
RETRO SEARCH

QUESTION NO.- 1145942.001
DEMO: 97-99-4
TOXICITY

Title List

October 31, 2001
Technical Specialist- Jim Brule

TO ORDER DOCUMENTS:

--- Follow this link: http://www.nerac.com/documents
--- Call NERAC Document Services at 860-872-9331
--- Fax your request to 860-875-1749
--- Or send e-mail to documents@nerac.com

Please reference the NDN number of the document(s) you wish to order.

Citations from CAB INTERNATIONAL: CAB

1. NDN 191-0523-9906-0: **Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents.**

Citations from CA SEARCH (94-97): CA2

2. NDN 171-0028-4027-3: **Comparison of in vivo and in vitro toxicity tests from co-inertia analysis**
CAS SECTION- 104
CAS SUBSECTION- 001

Citations from CA SEARCH (84-89): CA4

3. NDN 152-0531-1484-9: **CYTOTOXICITY TESTING OF 114 COMPOUNDS BY THE DETERMINATION OF THE PROTEIN CONTENT IN HEP G2 CELL CULTURES**
CAS SECTION- 104
CAS SUBSECTION- 003

4. NDN 152-0384-1385-0: **TOXICITY OF AGROCHEMICALS TO FRESHWATER ORGANISM. CIII. SOLVENTS**
CAS SECTION- 104
CAS SUBSECTION- 003

Citations from EMBASE: EMB

5. NDN 196-0174-4398-8: **Organic solvents for pharmaceutical parenterals and embolic liquids: A review of toxicity data**

Citations from INTERNATIONAL PHARMACEUTICALS ABSTRACTS: IPA

6. NDN 118-0100-8257-1: **Digitalis antagonism by a specific lactone**

Citations from NIOSHTIC: NIO

7. NDN 148-0007-5341-9: **Compatibility of Organic Solvents With the Salmonella/Microsome Test**

8. NDN 148-0002-6667-3: **The Determination of the Maximum Permissible Content of Tetrahydrofuryl Alcohol in Water Bodies**

Citations from REGISTRY OF TOXIC EFFECTS: RTC

9. NDN 145-0341-5421-4: **2-Furanmethanol, tetrahydro-**

10. NDN 145-0326-2971-7: **2-Furanmethanol, tetrahydro-**

Citations from CAB INTERNATIONAL: CAB

1. Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents.

CAB 93-11 932335695 NDN- 191-0523-9906-0

Doyel, K. J.; McKillip, W. J.; Shin, C. C.; Rickard, D. A.

1992
PP. 225-234
DOCUMENT TYPE- UP
COLLECTION TITLE- Adjuvants for agrichemicals Ýedited by Foy, C.L.¨.
ISBN- 0-8493-6317-9
AUTHOR AFFILIATION- QO Chemicals Inc., West Lafayette, Indiana, USA.
SUPPLEMENTARY NOTE(S)- 7 ref., based on the Second International Symposium on Adjuvants for Agrichemicals, Blacksburg, USA, 31 July-3 August 1989
SUBFILE- Weed Abstracts, (0W Vol. 042 Abs. No. 04551)
SUBFILE CODE- 0M; 0W
PUBLISHER- Boca Raton, Florida, USA; CRC Press, Inc.
LANGUAGE- English

The characteristics of the adjuvant tetrahydrofurfuryl alcohol (THFA) are described. It has low toxicity , low volatility, biodegradability and high solvency in organic and aqueous systems. The solubility of THFA with some well-known agricultural a.i.s. was investigated, and results are compared with those from other widely-used solvents and carriers.

DESCRIPTOR(S)- adjuvants; Adjuvants for agrichemicals; application; characteristics; Conferences; Herbicides
SECTION HEADING CODE- 0W810; 0M05
SECTION HEADING- APPLICATION AND MACHINERY; FUNGICIDES
SECONDARY SECTION HEADING CODE(S)- 0W801; 0W804

Citations from CA SEARCH (94-97): CA2

2. Comparison of in vivo and in vitro toxicity tests from co-inertia analysis

CAS SECTION- 104
CAS SUBSECTION- 001
CAS 122-12 122-284040 122:284040 NDN- 171-0028-4027-3

Devillers, James; Chessel, Daniel

ABBREVIATED JOURNAL TITLE- ACS Symp. Ser.
VOL. 589
VOLUME TITLE- Computer-Aided Molecular Design
1995
PP. 250-66
DOCUMENT TYPE- Journal
ISSN- 0097-6156
CODEN- ACSMC8
CORPORATE AUTHOR- Centre de Traitement de l'Information Scientifique, Lyons, FR, Fr., 69003
SUBFILE CODE- BIC
LANGUAGE- Eng

NO-ABSTRACT

IDENTIFIER(S)- in vivo vitro toxicity test eye

CAS REGISTRY/EC NUMBER(S)- 56-81-5 **HEADING PARENT**- 1,2,3-Propanetriol
CAS REGISTRY/EC NUMBER(S)- 57-55-6 **HEADING PARENT**- 1,2-Propanediol
CAS REGISTRY/EC NUMBER(S)- 64-17-5 **HEADING PARENT**- Ethanol
CAS REGISTRY/EC NUMBER(S)- 64-19-7 **HEADING PARENT**- Acetic acid
CAS REGISTRY/EC NUMBER(S)- 67-56-1 **HEADING PARENT**- Methanol
CAS REGISTRY/EC NUMBER(S)- 67-64-1 **HEADING PARENT**- 2-Propanone
CAS REGISTRY/EC NUMBER(S)- 67-66-3 **HEADING PARENT**- Methane --trichloro-
CAS REGISTRY/EC NUMBER(S)- 67-68-5 **HEADING PARENT**- Methane --sulfinylbis-
CAS REGISTRY/EC NUMBER(S)- 68-11-1 **HEADING PARENT**- Acetic acid --mercapto-
CAS REGISTRY/EC NUMBER(S)- 71-36-3 **HEADING PARENT**- 1-Butanol
CAS REGISTRY/EC NUMBER(S)- 75-12-7 **HEADING PARENT**- Formamide
CAS REGISTRY/EC NUMBER(S)- 78-93-3 **HEADING PARENT**- 2-Butanone
CAS REGISTRY/EC NUMBER(S)- 97-99-4 **HEADING PARENT**- 2-Furanmethanol --tetrahydro-
CAS REGISTRY/EC NUMBER(S)- 100-79-8 **HEADING PARENT**- 1,3-Dioxolane-4-methanol --2,2-dimethyl-

CAS REGISTRY/EC NUMBER(S)- 102-76-1 **HEADING PARENT**- 1,2,3-Propanetriol
CAS REGISTRY/EC NUMBER(S)- 107-18-6 **HEADING PARENT**- 2-Propen-1-ol
CAS REGISTRY/EC NUMBER(S)- 108-88-3 **HEADING PARENT**- Benzene --methyl-
CAS REGISTRY/EC NUMBER(S)- 109-86-4 **HEADING PARENT**- Ethanol --2-methoxy-
CAS REGISTRY/EC NUMBER(S)- 109-89-7 **HEADING PARENT**- Ethanamine --N-ethyl-
CAS REGISTRY/EC NUMBER(S)- 111-76-2 **HEADING PARENT**- Ethanol --2-butoxy-
CAS REGISTRY/EC NUMBER(S)- 111-87-5 **HEADING PARENT**- 1-Octanol
CAS REGISTRY/EC NUMBER(S)- 111-90-0 **HEADING PARENT**- Ethanol --2-(2-ethoxyethoxy)-
CAS REGISTRY/EC NUMBER(S)- 123-39-7 **HEADING PARENT**- Formamide --N-methyl-
CAS REGISTRY/EC NUMBER(S)- 127-09-3 **HEADING PARENT**- Acetic acid
CAS REGISTRY/EC NUMBER(S)- 151-21-3 **HEADING PARENT**- Sulfuric acid monododecyl ester sodium salt
CAS REGISTRY/EC NUMBER(S)- 1310-73-2 **HEADING PARENT**- Sodium hydroxide
CAS REGISTRY/EC NUMBER(S)- 7647-01-0 **HEADING PARENT**- Hydrochloric acid
CAS REGISTRY/EC NUMBER(S)- 7664-38-2 **HEADING PARENT**- Phosphoric acid
CAS REGISTRY/EC NUMBER(S)- 7664-93-9 **HEADING PARENT**- Sulfuric acid
CAS REGISTRY/EC NUMBER(S)- 7761-88-8 **HEADING PARENT**- Nitric acid silver(1+) salt
CAS REGISTRY/EC NUMBER(S)- 9002-93-1 **HEADING PARENT**- Poly(oxy-1,2-ethanediyl) --.alpha.-Ý4-(1,1,3,3-tetramethylbutyl)phenyl¨-.omega.-hydroxy-
CAS REGISTRY/EC NUMBER(S)- 9005-65-6 **HEADING PARENT**- Sorbitan

Citations from CA SEARCH (84-89): CA4

3. CYTOTOXICITY TESTING OF 114 COMPOUNDS BY THE DETERMINATION OF THE PROTEIN CONTENT IN HEP G2 CELL CULTURES
CAS SECTION- 104
CAS SUBSECTION- 003
CAS 111-11 111-188936 CA 111:188936 NDN- 152-0531-1484-9

DIERICKX, P. J.

TOXICOL. IN VITRO, 1989, VOL.3, ISS.3, PP.189-93
DOCUMENT TYPE- JOURNAL
CODEN- TIVIEQ
LOCATION OF WORK- INST. HYG. EPIDEMIOL., BRUSSELS B-1050, BELG.
SUBFILE CODE- BIC
LANGUAGE- ENGLISH

NO-ABSTRACT

DESCRIPTOR(S)- CYTOTOXICITY XENOBIOTIC HEP G2 CELL
CAS REGISTRY/EC NUMBER(S)- 50-00-0; 50-99-7; 56-81-5; 57-13-6; 57-50-1; 57-55-6; 60-35-5; 62-54-4; 62-56-6; 64-02-8; 64-17-5; 64-18-6; 64-19-7; 65-85-0; 67-56-1; 67-63-0; 67-64-1; 67-68-5; 68-04-2; 68-11-1; 68-12-2; 70-18-8; 71-23-8; 71-36-3; 71-41-0; 75-05-8; 75-12-7; 76-03-9; 77-92-9; 78-83-1; 78-93-3; 79-06-1; 79-09-4; 79-11-8; 79-36-7; 79-43-6; 87-69-4; 96-33-3; 97-99-4; 100-79-8; 102-71-6; 102-76-1; 106-50-3; 107-07-3; 107-10-8; 107-18-6; 107-92-6; 108-05-4; 108-95-2; 109-86-4; 109-89-7; 109-99-9; 110-15-6; 110-16-7; 111-42-2; 111-70-6; 111-87-5; 111-90-0; 113-24-6; 121-44-8; 121-57-3; 123-39-7; 123-91-1; 127-09-3; 141-43-5; 141-78-6; 141-97-9; 144-55-8; 144-62-7; 151-21-3; 288-32-4; 302-17-0; 497-19-8; 515-74-2; 591-27-5; 609-99-4; 640-19-7; 693-98-1; 1184-66-3; 1310-73-2; 1330-43-4; 3724-65-0; 5064-31-3; 5470-11-1; 6915-15-7; 7447-39-4; 7487-94-7; 7558-79-4; 7631-99-4; 7646-79-9; 7646-85-7; 7647-01-0; 7647-14-5; 7664-38-2; 7664-41-7; 7664-93-9; 7681-52-9; 7697-37-2; 7718-54-9; 7757-82-6; 7757-83-7; 7778-50-9; 7778-77-0; 9002-92-0; 9002-93-1; 9005-64-5; 9005-65-6; 10043-35-3; 10043-52-4; 10108-64-2; 10361-37-2; 11132-78-8; 12125-02-9

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4. TOXICITY OF AGROCHEMICALS TO FRESHWATER ORGANISM. CIII. SOLVENTS
CAS SECTION- 104
CAS SUBSECTION- 003
CAS 105-09 105-147635 CA 105:147635 NDN- 152-0384-1385-0

NISHIUCHI, YASUHIRO

SUISAN ZOSHOKU, 1984, VOL.32, ISS.2, PP.115-19
DOCUMENT TYPE- JOURNAL
CODEN- SUZOAV
LOCATION OF WORK- NOYAKU KENSHASHO, JAPAN
SUBFILE CODE- BIC
LANGUAGE- JAPANESE

NO-ABSTRACT

DESCRIPTOR(S)- SOLVENT TOXICITY FROG TADPOLE
CAS REGISTRY/EC NUMBER(S)- 50-00-0; 64-17-5; 67-56-1; 67-64-1; 74-89-5; 75-12-7; 75-31-0; 75-86-5; 78-40-0; 78-81-9; 78-89-7; 78-90-0; 79-09-4; 79-43-6; 96-24-2; 97-64-3; 97-99-4; 98-00-0; 100-37-8; 100-74-3; 102-79-4; 102-81-8; 106-69-4; 107-07-3; 107-15-3; 107-21-1; 107-41-5; 107-92-6; 108-01-0; 108-47-4; 108-89-4; 108-91-8; 108-99-6; 109-06-8; 109-59-1; 109-73-9; 109-86-4; 109-89-7; 109-99-9; 110-13-4; 110-49-6; 110-58-7; 110-63-4; 110-91-8; 111-29-5; 111-40-0; 111-42-2; 111-76-2; 111-77-3; 111-96-6; 112-15-2; 112-27-6; 112-34-5; 112-36-7; 112-50-5; 112-60-7; 121-44-8; 123-42-2; 139-87-7; 141-43-5; 142-68-7; 504-63-2; 547-64-8; 628-68-2; 1320-67-8; 6942-58-1; 7647-01-0; 13952-84-6; 20324-32-7; 25265-71-8; 25322-69-4; 25395-31-7; 25498-49-1; 26446-35-5

Citations from EMBASE: EMB

---

5. Organic solvents for pharmaceutical parenterals and embolic liquids: A review of toxicity data

EMB 00-51 2000422342 NDN- 196-0174-4398-8

Mottu, F.; Laurent, A.; Rufenacht, D. A.; Doelker, E.

JOURNAL NAME- PDA Journal of Pharmaceutical Science and Technology
54/6 (456-469)
DOCUMENT TYPE- Journal

ISSN- 1079-7440
PUBLICATION YEAR- 2000
CODEN- JPHTE
EMAIL- Eric.Doelker@pharm.unige.ch
AUTHOR/INVENTOR ADDRESS- E. Doelker, School of Pharmacy, University of Geneva, 30 quai Ernest Ansermet, CH-1211 Geneva 4
COUNTRY OF AUTHOR- Switzerland
PUBLICATION COUNTRY- United States
LANGUAGE- ENGLISH

ABSTRACT SUMMARY- Non-aqueous solvents have long been used in subcutaneous or intramuscular pharmaceutical formulations to dissolve water-insoluble drugs. In recent years, the need for these vehicles was increased ...

NO-DESCRIPTORS .

Citations from INTERNATIONAL PHARMACEUTICALS ABSTRACTS: IPA

---

6. Digitalis antagonism by a specific lactone

IPA 71-00 32155 NDN- 118-0100-8257-1

Shafer, R. B.; Adicoff, A.

JOURNAL NAME- Current Therapeutic Research (USA)
VOL. 12
NO. Nov
1970
PP. 755-758
2 reference(s)
ISSN- 0011-393X
CODEN- CTCEA9
AUTHOR AFFILIATION- Minneapolis Veterans Administration Hospital, Minneapolis, Minnesota
LANGUAGE OF ABSTRACT- Spanish
LANGUAGE- English

This study was undertaken to determine the antagonistic effects of I.V. tetrahydrofurfuryl alcohol (THFA) 50 mg./kg. on induced digitalis toxicity in dogs. Four groups of dogs were studied: (1) those receiving THFA alone, (2) those receiving only digoxin, (3) those in which induced digitalis toxicity was treated with THFA , and (4) those pretreated with THFA prior to inducing digitalis toxicity . Only the dogs in the group which received digoxin alone survived.
ABSTRACTOR'S NAME- Richard M. Efman

DESCRIPTOR(S)- Alcohols --tetrahydrofurfuryl, intravenous, fails to prevent digoxin toxicity , in dogs; Toxicity studies --digoxin, prevention, I.V. tetrahydrofurfuryl alcohol ineffective, in dogs; Cardiac drugs --digoxin, toxicity , prevention, I.V. tetrahydrofurfuryl alcohol ineffective, in dogs; Drug interactions --digoxin, toxicity , I.V. tetrahydrofurfuryl alcohol ineffective as antidote, in dogs
CAS REGISTRY/EC NUMBER(S)- 20830-75-5
AHFS INFORMATION- Cardiac drugs, 24:04, digoxin
DRUG TERM(S)- Tetrahydrofurfuryl alcohol --intravenous, fails to prevent digoxin toxicity , in dogs; Digoxin -- toxicity, lack of antagonistic effects of I.V. tetrahydrofurfuryl alcohol, in dogs
CHEMICAL NAME- Digoxin

SECTION HEADING CODE- 04
SECTION HEADING- Toxicity
RELATED SECTION NUMBER(S)- 11
RELATED SECTION HEADING(S)- Pharmacology .

Citations from NIOSHTIC: NIO

7. Compatibility of Organic Solvents With the Salmonella/Microsome Test

NIO 73-00 NIOSH-00114803 NDN- 148-0007-5341-9

Maron, D.; Katzenellenbogen, J.; Ames, B. N.

1981-00-00
Mutation Research, Vol. 88, No. 4, pages 343-350, 14 references
DATE FILED- 1980-02-01
CODEN- MUREAV

The effects of solvents on the mutagenic action of benzo(a)pyrene (50328) BaP was studied in mutated Salmonella-typhimurium TA-100 bacteria. Fresh solutions of BaP were diluted in each test solvent and added in various concentrations to molten top agar in each culture plate. Rat liver microsomal S9 fractions were used as activators. The solvents tested were dimethyl-sulfoxide (67685), N,N-dimethylformamide (68122) (DMF), acetonitrile (75058), cyclohexane (110827), formamide (75127), 1-methyl-2-pyrrolidinone (872504) (1M2P), p-dioxane (123911), acetone (67641), ethylene-glycol-dimethyl-ether (110714) (EGDE), phenoxy-ethanol (122996), tetrahydrofurfuryl-alcohol (97994) (THFA), tetrahydrofuran (109999) (THF), glycerol-formal (5464288), and ethanol (64175). DMSO and glycerol-formal were compatible with the test up to concentrations of 500 microliters per plate. Formamide, acetonitrile, ethanol, acetone and p-dioxane were compatible in concentrations up to 200 microliters per plate, but toxic at 500 microliters per plate. THFA , 1M2P, DMF and EGDE could be used at 100 microliters per plate, and THF could be used at 50 microliters per plate. At 200 microliters per plate THFA was toxic . At 50 microliters per plate, 11 of 12 solvents produced mutagen colony curves with B(a)P which deviated less than 25 percent from the control curve produced by DMSO; the curve for THFA was 60 percent higher than for DMSO. Cyclohexane at 200 microliters per plate apparently inhibited the S9 microsomal activation. In the more stringent modification of the test, no solvent could be used at 500 microliters. The authors conclude that a number of organic solvents are available for use with the Salmonella plate test for mutagenicity.

DESCRIPTOR(S)- Bioassays; Biochemical tests; Comparative toxicology ; Hepatic microsomal enzymes; Microorganisms; Mutagenesis; Organic solvents; Screening methods .

8. The Determination of the Maximum Permissible Content of Tetrahydrofuryl Alcohol in Water Bodies

NIO 73-00 NIOSH-00065865 NDN- 148-0002-6667-3

Pozdnyakov, A. G.

1967-00-00
Hygiene and Sanitation, Vol. 32, Environmental Protection Agency and National Science Foundation (Gigiena i Sanitariia), Washington, D. C., pages 273-277, 5 references
DATE FILED- 1965-09-09
CODEN- HYSAAV

The effects of tetrahydrofuryl (THF) alcohol on bodies of water were studied. The odor perception threshold of this substance is 8.6 mg/liter. THF alcohol in a concentration of 1 mg/liter does not alter the biological oxygen demand. The ineffective dose of THF alcohol in long term experimental studies was 5 mg/kg or 100 mg/liter. The maximum permissible concentration of THF alcohol recommended is 1 mg/liter, with general sanitary conditions as the limiting index. THF alcohol enters water bodies as part of the effluents from certain manufacturing plants.

DESCRIPTOR(S)- Contaminants; MAC's; Sanitation; Standards; Toxic substances list; Toxicity ; Toxicology ; 7732185; 7782447; 97994 .

Citations from REGISTRY OF TOXIC EFFECTS: RTC

9. 2-Furanmethanol, tetrahydro-

RTC 01-01 LY5922000 NDN- 145-0341-5421-4

NO-AUTHOR

UPDATE DATE- 200012
MOLECULAR FORMULA- C5-H10-O2
RTECS NUMBER- LU2450000
MOLECULAR WEIGHT- 102.15
WISWESSER LINE- T5OTJ B1Q
SYNONYMS- Furfuryl alcohol, tetrahydro-; QO Thfa; Tetrahydro-2-furancarbinol; Tetrahydro-2-furanmethanol; Tetrahydrofurfuryl alcohol; Tetrahydrofurylalkohol (Czech); Tetrahydrofurfurylalkohol (Czech); Tetrahydro-2-furylmethanol; THFA
CLASS OF COMPOUND- Reproductive Effector; Primary Irritant

NO-ABSTRACT

CAS REGISTRY/EC NUMBER(S)- 97-99-4; 5-17-03-00115 (Beilstein Handbook Referen-ce-); BRN 0102-72-3 IRRITATION DATA
ROUTE OF ADMINISTRATION- administration into the eye (irritant)
ORGANISM OBSERVED- rabbit
DOSE DATA- 20 mg/24H MOD
CODEN- Prehled Prumyslove Toxikologie; Organicke Latky. Volume(issue)/page/year: -,786,1986. 85JCAE REPRODUCTIVE EFFECTS DATA
BIOMEDICAL MANIFESTATION- Reproductive - Paternal Effects - Spermatogenesis (including genetic material, sperm morphology, motility, and count) Reproductive - Paternal Effects - Testes, epididymis, sperm duct Reproductive - Paternal Effects - Prostate, seminal vesicle, Cowper's gland, accessory glands
ROUTE OF ADMINISTRATION- inhalation
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TCLo
DOSE DATA- 500 ppm/6H (13W male)
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0557931. NTIS**
BIOMEDICAL MANIFESTATION- Reproductive - Paternal Effects - Spermatogenesis (including genetic material, sperm morphology, motility, and count)
ROUTE OF ADMINISTRATION- administration onto the skin
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 65 gm/kg (13W male)
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0557932. NTIS** TOXICITY EFFECTS DATA
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 1600 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
ROUTE OF ADMINISTRATION- intraperitoneal
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 400 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
BIOMEDICAL MANIFESTATION- Behavioral - General anesthetic
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- mouse
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 2300 mg/kg
CODEN- Hygiene and Sanitation (USSR). English translation of GISAAA. Volume(issue)/page/year: 32 (2),273,1967. HYSAAV
ROUTE OF ADMINISTRATION- intravenous
ORGANISM OBSERVED- rabbit
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 725 mg/kg

CODEN- Federation Proceedings, Federation of American Societies for Experimental Biology. Volume (issue)/page/year: 8,294,1949. FEPRA7
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- guinea pig
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 800 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
ROUTE OF ADMINISTRATION- administration onto the skin
ORGANISM OBSERVED- guinea pig
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 5 gm/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
ROUTE OF ADMINISTRATION- intraperitoneal
ORGANISM OBSERVED- guinea pig
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 400 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
OTHER MULTIPLE DOSE TOXICITY DATA
BIOMEDICAL MANIFESTATION- Nutritional and Gross Metabolic - Weight loss or decreased weight gain - Z73
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 54 gm/kg/90D-C
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0535211. NTIS**
BIOMEDICAL MANIFESTATION- Behavioral - Convulsions or effect on seizure threshold Blood - P73 - Z72
ROUTE OF ADMINISTRATION- inhalation
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TCLo
DOSE DATA- 500 ppm/6H/13W-I
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0557931. NTIS**
BIOMEDICAL MANIFESTATION- Nutritional and Gross Metabolic - Weight loss or decreased weight gain
ROUTE OF ADMINISTRATION- administration onto the skin
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 65 gm/kg/13W-I
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0556424. NTIS**
BIOMEDICAL MANIFESTATION- Behavioral - Somnolence (general depressed activity) Behavioral - Food intake (animal) Nutritional and Gross Metabolic - Weight loss or decreased weight gain
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 1500 mg/kg/5D-I
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0535211-2. NTIS**
STANDARDS AND REGULATIONS
SURVEY(S)- NOHS 1974: HZD 83085; NIS 9; TNF 1654; NOS 9; TNE 2169
SURVEY(S)- NOES 1983: HZD 83085; NIS 41; TNF 5004; NOS 33; TNE 81543; TFE 48075 ATSDR, EPA, NIOSH, NTP, AND OSHA STATUS
STATUS- EPA TSCA Section 8(b) CHEMICAL INVENTORY .

---

10. 2-Furanmethanol, tetrahydro-

RTC 00-04 LY5922000 NDN- 145-0326-2971-7

NO-AUTHOR

UPDATE DATE- 200009
MOLECULAR FORMULA- C5-H10-O2
RTECS NUMBER- LU2450000
MOLECULAR WEIGHT- 102.15
WISWESSER LINE- T5OTJ B1Q
SYNONYMS- Furfuryl alcohol, tetrahydro-; QO Thfa; Tetrahydro-2-furancarbinol; Tetrahydro-2-furanmethanol; Tetrahydrofurfuryl alcohol; Tetrahydrofurylalkohol (Czech); Tetrahydrofurfurylalkohol (Czech); Tetrahydro-2-furylmethanol; THFA
CLASS OF COMPOUND- Reproductive Effector; Primary Irritant

NO-ABSTRACT

CAS REGISTRY/EC NUMBER(S)- 97-99-4; 5-17-03-00115 (Beilstein Handbook Referen-ce-); BRN 0102-72-3 IRRITATION DATA
ROUTE OF ADMINISTRATION- administration into the eye (irritant)
ORGANISM OBSERVED- rabbit
DOSE DATA- 20 mg/24H MOD
CODEN- Prehled Prumyslove Toxikologie; Organicke Latky. Volume(issue)/page/year: -,786,1986. 85JCAE REPRODUCTIVE EFFECTS DATA
BIOMEDICAL MANIFESTATION- Reproductive - Paternal Effects - Spermatogenesis (including genetic material, sperm morphology, motility, and count) Reproductive - Paternal Effects - Testes, epididymis, sperm duct Reproductive - Paternal Effects - Prostate, seminal vesicle, Cowper's gland, accessory glands
ROUTE OF ADMINISTRATION- inhalation
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TCLo
DOSE DATA- 500 ppm/6H (13W male)
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0557931. NTIS**
BIOMEDICAL MANIFESTATION- Reproductive - Paternal Effects - Spermatogenesis (including genetic material, sperm morphology, motility, and count)
ROUTE OF ADMINISTRATION- administration onto the skin
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 65 gm/kg (13W male)
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0557932. NTIS** TOXICITY EFFECTS DATA
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 1600 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
ROUTE OF ADMINISTRATION- intraperitoneal
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 400 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
BIOMEDICAL MANIFESTATION- Behavioral - General anesthetic
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- mouse
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 2300 mg/kg
CODEN- Hygiene and Sanitation (USSR). English translation of GISAAA. Volume(issue)/page/year: 32 (2),273,1967. HYSAAV
ROUTE OF ADMINISTRATION- intravenous
ORGANISM OBSERVED- rabbit
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 725 mg/kg
CODEN- Federation Proceedings, Federation of American Societies for Experimental Biology. Volume (issue)/page/year: 8,294,1949. FEPRA7
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- guinea pig
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 800 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
ROUTE OF ADMINISTRATION- administration onto the skin
ORGANISM OBSERVED- guinea pig
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 5 gm/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ
ROUTE OF ADMINISTRATION- intraperitoneal
ORGANISM OBSERVED- guinea pig
DESCRIPTION OF EXPOSURE- LD50
DOSE DATA- 400 mg/kg
CODEN- Patty's Industrial Hygiene and Toxicology. Volume(issue)/page/year: 2C,4658,1982. 38MKAJ OTHER MULTIPLE DOSE TOXICITY DATA
BIOMEDICAL MANIFESTATION- Nutritional and Gross Metabolic - Weight loss or decreased weight gain - Z73
ROUTE OF ADMINISTRATION- oral

ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 54 gm/kg/90D-C
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0535211. NTIS**
BIOMEDICAL MANIFESTATION- Behavioral - Convulsions or effect on seizure threshold Blood - P73 - Z72
ROUTE OF ADMINISTRATION- inhalation
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TCLo
DOSE DATA- 500 ppm/6H/13W-I
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0557931. NTIS**
BIOMEDICAL MANIFESTATION- Behavioral - Somnolence (general depressed activity) Behavioral - Food intake (animal) Nutritional and Gross Metabolic - Weight loss or decreased weight gain
ROUTE OF ADMINISTRATION- oral
ORGANISM OBSERVED- rat
DESCRIPTION OF EXPOSURE- TDLo
DOSE DATA- 1500 mg/kg/5D-I
CODEN- National Technical Information Service. Volume(issue)/page/year: OTS0535211-2. NTIS**
STANDARDS AND REGULATIONS
SURVEY(S)- NOHS 1974: HZD 83085; NIS 9; TNF 1654; NOS 9; TNE 2169
SURVEY(S)- NOES 1983: HZD 83085; NIS 41; TNF 5004; NOS 33; TNE 81543; TFE 48075 ATSDR, EPA, NIOSH, NTP, AND OSHA STATUS
STATUS- EPA TSCA Section 8(b) CHEMICAL INVENTORY .

Brock, Darryl

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Profile Recipients: Mr. Darryl Brock
Regulatory Manager
American Vanguard Corporation
Suite 1250
4695 MacArthur Court
Newport Beach, CA 92660

Topic Title: DEMO: 97-99-4 FDA

Topic 002 JEB Date: 10-31-2001

Strategy 01 JEB Date: 10-31-2001 Hit Limit: 025 Copies: 001

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001	09	01	THFA\AL\VT
002	08	01	97-99-4\RF\RN
003	07	01	TETRAHYDRO-2-FURYLMETHANOL\AL
004	06	01	TETRAHYDRO-2-FURYLMETHANOL\VT
005	05	01	TETRAHYDRO-2-FURANMETHANOL\AL
006	04	01	TETRAHYDRO-2-FURANMETHANOL\VT
007	03	01	TETRAHYDROFURYL-ALCOHOL\AL\VT
008	02	01	TETRAHYDROFURYLALCOHOL\AL\VT
009	01	98	TETRAHYDROFURYL<1N>ALCOHOL\AL\VT
010	99	01	FDA\AL\CS\KN
011	99	01	FDA-APPROV???\AL\VT
012	99	01	FOOD\AL\VT\CS
013	99	01	FOODS\AL\VT\CS
014	99	01	FOODSTUFF\AL\VT\CS
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Citations from Federal Research in Progress (FRP): FRP

1. NDN 049-0199-3330-9: **EVALUATION OF ELECTROHEATING TECHNOLOGY FOR UHT PROCESSING OF MILK**

---

1. EVALUATION OF ELECTROHEATING TECHNOLOGY FOR UHT PROCESSING OF MILK

FRP 01-07 0175877 NDN- 049-0199-3330-9

NO-AUTHOR

AGENCY- AGRIC
CORPORATE AUTHOR- UTAH STATE UNIVERSITY, NUTRITION & FOOD SCIENCE
LOGAN
UTAH
84322
AWARD TYPE- NRI COMPETITIVE GRANT .c C

9703491. The main objective of this research is to obtain basic information on some functional, physical, and chemical properties of heated milk processed through electroheating. This study will use the electroheating technology to produce UHT milk. Suitable heating temperatures and holding times will be used. The electroheated milk will be stored and their properties evaluated at regular intervals for a period of up to 10-12 weeks. Sensory tests will be conducted using a trained panel. Tests for color, flavor, and whey protein denaturation will be conducted and compared with the values for milk processed using the conventional method or a commercial UHT milk. Response surface methodology approach will be adopted to describe the relationship of dependent variables to product quality and process parameters.PR uniform heating and a very rapid heating rate (e.g., heating times from 80 C to 155 C of 0.1 s), no fouling or scorching of the product the heat exchanger and low heat losses (because the product and not the container is heated by the electrical current), and no residual heating after the current is shut off. Pasteurized 1% and 2% milks were ultra-high temperature (UHT) processed using a heating system developed by Raztek Corporation that uses an alternating current to rapidly heat fluid products. Conditions used for UHT processing were 155 C for 1 s (T1), 145 C for 1 S (T2), 145 C for 4 S (T3) and 135 C for 4 S (T4). The experimental milks were then compared to a control commercially-available UHT milk for: extent of whey protein denaturation (in comparison to pasteurized milk), sensory flavor attributes by sensory evaluation by trained and consumer panels, and volatile flavor compounds by gas chromatography. The trained panel was used to rate the intensity of taste and flavor attributes while the consumer panels were used to rate consumers' opinions about the milk samples. In comparison to th econtrol UHT milk, there was only half the whey-protein denaturation in the electroheated milks (i.e., only 21-37% for milk T1-T4) which is indicative of the rapid heating rate during electroheating. As

judged by the trained panel, the electroheated milks had lower oxidized, stale, butter flavor attributes, and scored higher for sweet flavor than the control UHT milk. Milk that was electroheated to 145 C for 1 s (milk T2) had sensory scores of 1.1, 0.6, 0.5, and 1.6 for these attributes respectively, while the control UHT milk scored 1.8, 1.4, 1.2 and 0.9. There were no significant differences between the milks for the attributes of sour, salty, bitter, dairy or cooked flavors. Compared to the control UHT milk, the electroheated milk was lower in overall volatiles, although they contained higher levels of 2-heptanone, 2-nonanone, and nonanal. Two heat process-derived compounds 3-furanmethanol and tetrahydro-2-furanmethanol that were present in the control UHT milk were absent in the electroheated milks. On a hedonic scale in which 9 was like extremely, 5 was neither like nor dislike, and 1 was dislike extremely, the overall liking scores of the electroheated UHT milks were higher than the control UHT, milk, with scores of 6.1 (like slightly) for milk T2 while the control scored 3.8 (dislike slightly). Panelists were also asked to compare the UHT milks to the milk they normally drink. For the control milk, 9% rated it better than, 15% rated it equal to, while 76% rated it worse than the milk they normally drink. In contrast, for the electroheated milk T2, 15% rated it better than, 49% rated it equal to, and only 37% rated it worse than the milk they normally drink. Thus the proportion of panelists who rated the UHT milk worse than the milk they normally drink was decreased by half. When combining the top two categories, 63% thought that the electroheated UHT milk was better than or equal to the milk they normally drink, compared to 24% for the control UHT milk.PB

DESCRIPTOR(S)- DEVELOPMENTFUNCTIONAL; ENGINEERINGAGRICULTURAL; ENGINEERINGDAIRY; EVALUATIONCOLOR; EVALUATIONRESPONSE; HIGH; METHODS; PROCESSINGMILKULTRA; PRODUCTSFOOD; PROPERTIESCHEMICAL; PROPERTIESPHYSICAL; PROPERTIESSENSORY; PROTEINSTIME; STABILITYFLAVOR; STABILITYWHEY; STUDIESQUALITY; SURFACE; TEMPERATUREHEATINGPROCESS .

Brock, Darryl

From: JEB@nerac.com
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DEMO: 97-99-4 PESTICIDE
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QUESTION NO.- 1145942.003
DEMO: 97-99-4
PESTICIDE

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Citation Information

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Technical Specialist- Jim Brule

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Citations from CAS - COMBINED DIVISIONS: CAS

1. NDN 213-0431-9406-0: **Synergistic pesticidal compositions containing essential oils with enzyme inhibitors**
CAS SECTION- 105
CAS SUBSECTION- 004

Citations from CA SEARCH (79-84): CA5

2. NDN 153-0432-0848-2: **SLOW-RELEASE FRAGRANCE OR PESTICIDE PREPARATIONS**

CAS SECTION- 162
CAS SUBSECTION- 005

3. NDN 153-0337-5739-0: **AROMATIC PESTICIDES**
CAS SECTION- 025
CAS SUBSECTION- 019

Citations from CAS - COMBINED DIVISIONS: CAS

1. Synergistic pesticidal compositions containing essential oils with enzyme inhibitors
CAS SECTION- 105
CAS SUBSECTION- 004
CAS 134-07 134-082193 134:082193 NDN- 213-0431-9406-0

INVENTOR(S)- Bessette, Steven M.

2001-01-04
24 page(s)
PATENT NUMBER- 01 00026
PATENT APPLICATION NUMBER- 1999-21009/US-A1
DATE FILED- 1999-09-15

DOCUMENT TYPE- Patent; Primary Pub. Type - Patent
CODEN- PIXXD2
CORPORATE AUTHOR- US, USA
COUNTRY- WO
PATENT TYPE- PCT Int. Appl.
PATENT ASSIGNEE(S)- Ecosmart Technologies, Inc.
INTERNATIONAL PATENT CLASS- A01N0433000; A01N0373200; A01N0433000; A01N0650000; A01N0311600; A01N0310800; A01N0310400
SUBFILE CODE- BIC
PATENT APPLICATION PRIORITY- 1999/06/28, US-340391
DESG. REGIONAL COUNTRIES- GH; GM; KE; LS; MW; SD; SL; SZ; TZ; UG; ZW; AT; BE; CH; CY; DE; DK; ES; FI; FR; GB; GR; IE; IT; LU; MC; NL; PT; SE; BF; BJ; CF; CG; CI; CM; GA; GN; GW; ML; MR; NE; SN; TD; TG
DESG. COUNTRIES- AE; AL; AM; AT; AU; AZ; BA; BB; BG; BR; BY; CA; CH; CN; CR; CU; CZ; DE; DK; EE; ES; FI; GB; GD; GE; GH; GM; HR; HU; ID; IL; IN; IS; JP; KE; KG; KP; KR; KZ; LC; LK; LR; LS; LT; LU; LV; MD; MG; MK; MN; MW; MX; NO; NZ; PL; PT; RO; RU; SD; SE; SG; SI; SK; SL; TJ; TM; TR; TT; UA; UG; US; UZ; VN; YU; ZA; ZW; AM; AZ; BY; KG; KZ; MD; RU; TJ; TM
LANGUAGE- Eng

NO-ABSTRACT

IDENTIFIER(S)- synergism pesticide essential oil enzyme inhibitor

CAS REGISTRY/EC NUMBER(S)- 51-03-6 **HEADING PARENT**- 1,3-Benzodioxole --5-ÝÝ2-(2-butoxyethoxy)ethoxy¨methyl¨-6-propyl-
CAS REGISTRY/EC NUMBER(S)- 60-12-8 **HEADING PARENT**- Benzeneethanol
CAS REGISTRY/EC NUMBER(S)- 77-83-8 **HEADING PARENT**- Oxiranecarboxylic acid --3-methyl-3-phenyl-
CAS REGISTRY/EC NUMBER(S)- 84-66-2 **HEADING PARENT**- 1,2-Benzenedicarboxylic acid
CAS REGISTRY/EC NUMBER(S)- 89-78-1 **HEADING PARENT**- Cyclohexanol --5-methyl-2-(1-methylethyl)-

CAS REGISTRY/EC NUMBER(S)- 89-82-7 **HEADING PARENT**- Cyclohexanone --5-methyl-2-(1-methylethylidene)-
CAS REGISTRY/EC NUMBER(S)- 89-83-8 **HEADING PARENT**- Phenol --5-methyl-2-(1-methylethyl)-
CAS REGISTRY/EC NUMBER(S)- 90-05-1 **HEADING PARENT**- Phenol --2-methoxy-
CAS REGISTRY/EC NUMBER(S)- 97-53-0 **HEADING PARENT**- Phenol --2-methoxy-4-(2-propenyl)-
CAS REGISTRY/EC NUMBER(S)- 97-54-1 **HEADING PARENT**- Phenol --2-methoxy-4-(1-propenyl)-
→ **CAS REGISTRY/EC NUMBER(S)**- 97-99-4 **HEADING PARENT**- 2-Furanmethanol --tetrahydro-
CAS REGISTRY/EC NUMBER(S)- 98-55-5 **HEADING PARENT**- 3-Cyclohexene-1-methanol --.alpha.,.alpha.,4-trimethyl-
CAS REGISTRY/EC NUMBER(S)- 98-85-1 **HEADING PARENT**- Benzenemethanol --.alpha.-methyl-
CAS REGISTRY/EC NUMBER(S)- 99-48-9 **HEADING PARENT**- 2-Cyclohexen-1-ol --2-methyl-5-(1-methylethenyl)-
CAS REGISTRY/EC NUMBER(S)- 99-83-2 **HEADING PARENT**- 1,3-Cyclohexadiene --2-methyl-5-(1-methylethyl)-
CAS REGISTRY/EC NUMBER(S)- 99-87-6 **HEADING PARENT**- Benzene --1-methyl-4-(1-methylethyl)-
CAS REGISTRY/EC NUMBER(S)- 100-51-6 **HEADING PARENT**- Benzenemethanol
CAS REGISTRY/EC NUMBER(S)- 104-54-1 **HEADING PARENT**- 2-Propen-1-ol --3-phenyl-
CAS REGISTRY/EC NUMBER(S)- 104-55-2 **HEADING PARENT**- 2-Propenal --3-phenyl-
CAS REGISTRY/EC NUMBER(S)- 106-22-9 **HEADING PARENT**- 6-Octen-1-ol --3,7-dimethyl-
CAS REGISTRY/EC NUMBER(S)- 106-23-0 **HEADING PARENT**- 6-Octenal --3,7-dimethyl-
CAS REGISTRY/EC NUMBER(S)- 106-24-1 **HEADING PARENT**- 2,6-Octadien-1-ol --3,7-dimethyl-
CAS REGISTRY/EC NUMBER(S)- 119-36-8 **HEADING PARENT**- Benzoic acid --2-hydroxy-
CAS REGISTRY/EC NUMBER(S)- 120-45-6 **HEADING PARENT**- Benzenemethanol --.alpha.-methyl-
CAS REGISTRY/EC NUMBER(S)- 120-57-0 **HEADING PARENT**- 1,3-Benzodioxole-5-carboxaldehyde
CAS REGISTRY/EC NUMBER(S)- 121-32-4 **HEADING PARENT**- Benzaldehyde --3-ethoxy-4-hydroxy-
CAS REGISTRY/EC NUMBER(S)- 121-33-5 **HEADING PARENT**- Benzaldehyde --4-hydroxy-3-methoxy-
CAS REGISTRY/EC NUMBER(S)- 122-40-7 **HEADING PARENT**- Heptanal --2-(phenylmethylene)-
CAS REGISTRY/EC NUMBER(S)- 122-70-3 **HEADING PARENT**- Propanoic acid
CAS REGISTRY/EC NUMBER(S)- 123-11-5 **HEADING PARENT**- Benzaldehyde --4-methoxy-
CAS REGISTRY/EC NUMBER(S)- 134-20-3 **HEADING PARENT**- Benzoic acid --2-amino-
CAS REGISTRY/EC NUMBER(S)- 140-11-4 **HEADING PARENT**- Acetic acid
CAS REGISTRY/EC NUMBER(S)- 326-61-4 **HEADING PARENT**- 1,3-Benzodioxole-5-methanol
CAS REGISTRY/EC NUMBER(S)- 470-82-6 **HEADING PARENT**- 2-OxabicycloÝ2.2.2¨octane --1,3,3-trimethyl-
CAS REGISTRY/EC NUMBER(S)- 487-67-2 **HEADING PARENT**- 2-Cyclopenten-1-one --4-hydroxy-3-methyl-2-(2Z)-2,4-pentadienyl-

CAS REGISTRY/EC NUMBER(S)- 488-10-8 **HEADING PARENT**- 2-Cyclopenten-1-one --3-methyl-2-(2Z)-2-pentenyl-
CAS REGISTRY/EC NUMBER(S)- 495-76-1 **HEADING PARENT**- 1,3-Benzodioxole-5-methanol
CAS REGISTRY/EC NUMBER(S)- 499-75-2 **HEADING PARENT**- Phenol --2-methyl-5-(1-methylethyl)-
CAS REGISTRY/EC NUMBER(S)- 562-74-3 **HEADING PARENT**- 3-Cyclohexen-1-ol --4-methyl-1-(1-methylethyl)-
CAS REGISTRY/EC NUMBER(S)- 606-45-1 **HEADING PARENT**- Benzoic acid --2-methoxy-
CAS REGISTRY/EC NUMBER(S)- 1222-05-5 **HEADING PARENT**- CyclopentaÝg¨-2-benzopyran --1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethyl-
CAS REGISTRY/EC NUMBER(S)- 1335-46-2 **HEADING PARENT**- Ionone --methyl-
CAS REGISTRY/EC NUMBER(S)- 2050-08-0 **HEADING PARENT**- Benzoic acid --2-hydroxy-
CAS REGISTRY/EC NUMBER(S)- 2111-75-3 **HEADING PARENT**- 1-Cyclohexene-1-carboxaldehyde --4-(1-methylethenyl)-
CAS REGISTRY/EC NUMBER(S)- 4180-23-8 **HEADING PARENT**- Benzene --1-methoxy-.

Citations from CA SEARCH (79-84): CA5

---

2. SLOW-RELEASE FRAGRANCE OR PESTICIDE PREPARATIONS
CAS SECTION- 162
CAS SUBSECTION- 005

CAS 098-01 098-008092 CA 098:008092 NDN- 153-0432-0848-2

NO-AUTHOR

JPN. KOKAI TOKKYO KOHO, JUL 31 1982, 3 PP.
PATENT NUMBER- 82123277
PATENT APPLICATION NUMBER- 81-9350
DATE FILED- JAN 23 1981
DOCUMENT TYPE- PATENT
CODEN- JKXXAF
LOCATION OF WORK- JAPAN
PATENT CLASS- C09K00300000; A01N0250800-; A61L0090400-
PATENT ASSIGNEE(S)- JAPAN SYNTHETIC RUBBER CO., LTD.; NIPPON KURIETO K. K.
SUBFILE CODE- APP
ORIGINAL PATENT APPLICATION COUNTRY- JP
LANGUAGE- JAPANESE

NO-ABSTRACT

DESCRIPTOR(S)- SLOW RELEASE FRAGRANCE PESTICIDE GEL
CAS REGISTRY/EC NUMBER(S)- 97-99-4; 7631-86-9 .

---

3. AROMATIC PESTICIDES
CAS SECTION- 025
CAS SUBSECTION- 019

CAS 093-12 093-220489 CA 093:220489 NDN- 153-0337-5739-0

HUBELE, ADOLF; KUNZ, WALTER; ECKHARDT, WOLFGANG

GER. OFFEN., JUN 19 1980, 28 PP.
PATENT NUMBER- 2948734
PATENT APPLICATION NUMBER- 78-12519
DATE FILED- DEC 07 1978
DOCUMENT TYPE- PATENT
CODEN- GWXXBX
LOCATION OF WORK- SWITZ.
PATENT CLASS- C07C103-46; C07C121-34; C07C143-68; C07C149-23
PATENT ASSIGNEE(S)- CIBA-GEIGY A.-G.

SUBFILE CODE- ORG
ORIGINAL PATENT APPLICATION COUNTRY- SWISS
LANGUAGE- GERMAN

NO-ABSTRACT

DESCRIPTOR(S)- ANILINOPROPIONATE PREPN FUNGICIDE
CAS REGISTRY/EC NUMBER(S)- 97-99-4; 75462-37-2; 75462-38-3; 75462-39-4; 75462-40-7; 75462-41-8; 75462-42-9; 75462-43-0; 75462-44-1; 75462-45-2; 75462-46-3; 75477-60-0; 75596-99-5 .

APPENDIX VII

Journal article

Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents

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Title

Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents

Author

Doyel, K. J.; McKillip, W. J.; Shin, C. C.; Rickard, D. A.

Organization

QO Chem. Inc., West Lafayette, IN, USA

Publication Source

Adjuvants Agrichem. (1992), 225-34. Editor(s): Foy, Chester L. Publisher: CRC, Boca Raton, Fla.

Identifier-CODEN

58PBAT

Abstract

Tetrahydrofurfuryl alc. (THFA), as an agrochem. adjuvant has seen limited com. applications. THFA's underexploited status is believed due to a lack of publicly available data regarding its characteristics. Inherently low **toxicity**, low volatility, biodegradability, and high solvency in both org. and aq. systems make THFA an attractive candidate for use with agrochems. Studies were performed to characterize the chem. with respect to the utility of THFA in agrochem. adjuvant applications. The results are discussed in comparison to other widely used solvents and carriers. The data presented should provide formulators with another option when selecting formulation chem. for current or exptl. active ingredients.

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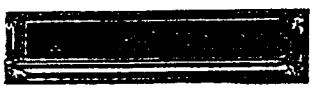

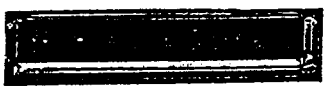

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Chapter 19

COMPARISON OF THE CYCLIC ETHER-ALCOHOL TETRAHYDROFURFURYL ALCOHOL TO OTHER KNOWN SOLVENTS

K. J. Doyel, W. J. McKillip, C. C. Shin, and D. A. Rickard

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ABSTRACT

Tetrahydrofurfuryl alcohol (THFA 2[tet]-tetrahydrofuryl methanol), as an agrichemical adjuvant that has seen limited commercial applications. THFA's underexploited status is believed due to a lack of publicly available data regarding its characteristics.

Inherently low toxicity, low volatility, biodegradability, and high solvency in both organic and aqueous systems make THFA an attractive candidate for use with agrichemicals. Studies were performed to characterize the chemical with respect to the utility of THFA in agrichemical adjuvant applications.

The results are discussed in comparison to other widely used solvents and carriers. The data presented should provide formulators with another option when selecting formulation chemistry for current or experimental active ingredients.

I. INTRODUCTION

If one endeavors to create a perfect solvent for use as a coupling agent with various active materials, it would have the characteristics shown in Table 1.[2]

The problem, however, is that few commercial compounds contain all of these attributes. Most commercial adjuvants have been chosen on the basis of cost and availability. Many of these products are well-known solvents and oils. Today, formulators and producers are finding utility in lesser known solvents based on the different cyclic compounds of pyrrole and furan.[3-5]

THFA is a colorless organic solution having the structure shown in Figure 1. THFA is unique in that its structure contains elements of an ether, an alcohol, and a cyclic molecule. THFA is produced commercially by the catalytic hydrogenation of furfural, the furan aldehyde. Furfural is obtained industrially from pentosan containing agricultural byproducts such as corncobs, rice hulls, oat hulls, cottonseed hulls, and sugarcane bagasse.[5]

THFA is unique in that it is easily miscible in water and most organic solvents. In addition, the product has low volatility and can aid in retarding evaporation. Table 2 contains a list of the physical properties of THFA.[5]

Recent findings of new toxicity levels of various solvents have caused some concern with manufacturers and formulators. To combat this, manufacturers are reformulating with different solvents which have lower toxicity characteristics. THFA is one such chemical that is receiving more attention based on its positive toxicity characteristics. Figure 2 compares THFA oral toxicity in rats to oral toxicity levels of other well-known EPA-exempt (40 CFR 180.1001) solvents. The table provides a direct comparison of one parameter, which may be different in other species or conditions.[6,7]

The purpose of this paper is twofold: (1) to introduce the reader to a solvent which has had little or no exposure in the area of agrichemicals and (2) to provide some basic experimental data on the solubility of THFA with well-known agricultural active ingredients.

II. MATERIALS AND METHODS

The experiment consisted of determining (1) the maximum solubility range of THFA with the chosen active ingredient, (2) the maximum solubility of the THFA/active ingredient mixture in water, and (3) if a 1:100 ratio of mixture to water would result in a stable solution.

Selection of the active ingredients for this experiment was based on the criteria of commercial use, lack of aqueous solubility, and general class of material. Table 3 lists the 52 active materials tested in this experiment. The materials were obtained from Chem Service, Inc., West Chester, PA, and the THFA, from QO Chemicals. All material was of commercial

TABLE 1
Characteristics of Solvents

Low toxicity
Low phytotoxicity
Low volatility
High flash point
Ability to solubilize many different active materials
Coupling ability
Biodegradability
Cost effectiveness

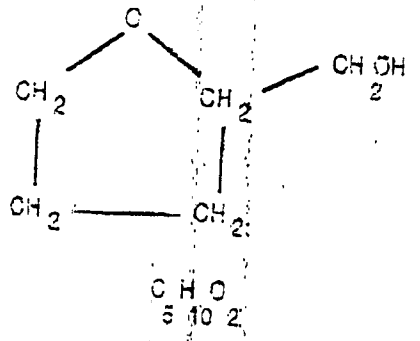

FIGURE 1. Chemical structure of tetrahydrofurfuryl alcohol (THFA).

TABLE 2
Characteristics of Tetrahydrofurfuryl Alcohol

Boiling point	178°C, 352°F
Freezing point	−80°C, −112°F
Vapor pressure	0.4 mmHg @ 20°C
Density	8.76 lbs/gal
Flash point	165°F TCC method
Soluble in	Water, alcohols, aromatics, esters, ethers, ketones, and chlorinated hydrocarbons
Insoluble in	Coconut, cottonseed, and peanut oils, anthraquinone, dextrose, and paraffinic hydrocarbons

EPA exemption from tolerance as a solvent/cosolvent with no limits per 40CFR 180.1001
Not phytotoxic in concentrations up to 25%

purity and was obtained uninhibited in order to eliminate the introduction of other variables to the test. The water for dilution was ordinary tap water provided by the city of Memphis, TN.[14]

A. THFA/ACTIVE MATERIAL SOLUBILITY

One gram of the selected active material was weighed and placed into a tared 20-ml vial. One gram of THFA was added to produce a 1:1 solution, and the vial was agitated in order to mix the two materials. The solution was visually inspected to determine solubility. If initially the THFA appeared to solubilize the material, the mixture was allowed to stand for 10 min and then reinspected to assure solubility. If the material was not completely solubilized, an additional 2g of THFA was added to produce a 1:1 solution. The same steps were repeated to visually inspect for solubility. The protocol was repeated at concentrations

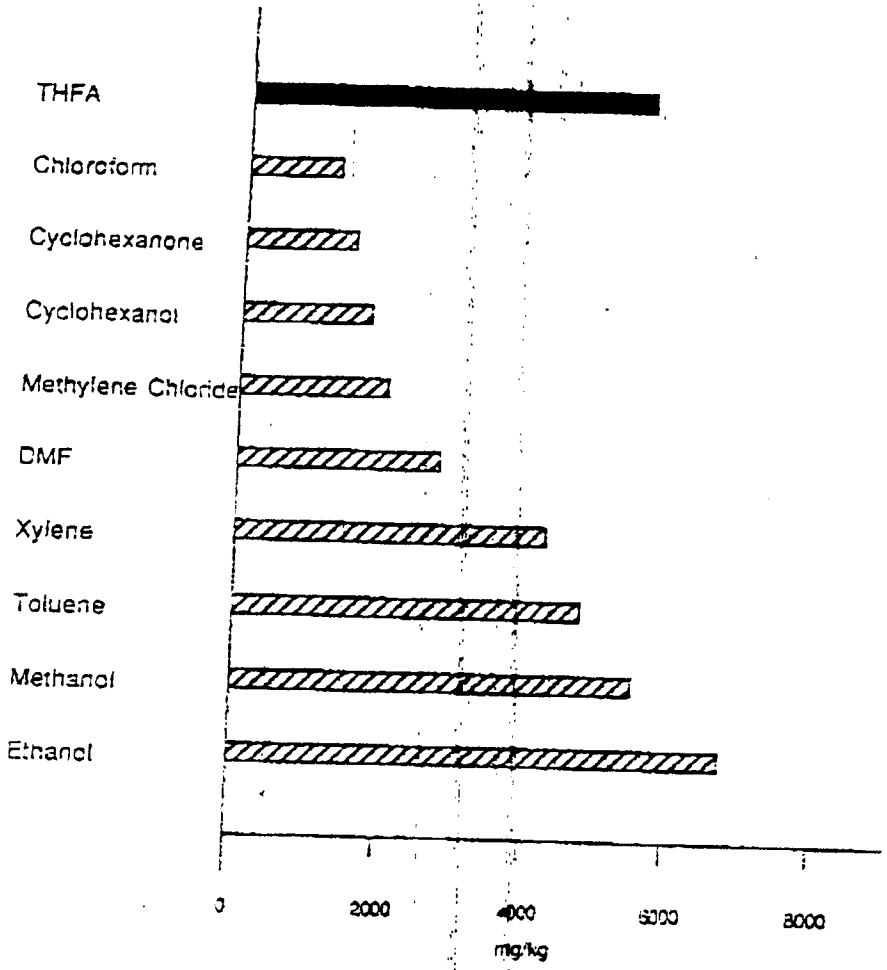

FIGURE 2. Toxicity levels of various solvents (oral toxicity to rats LD_{50}).

of 1:9, 1:19, 1:99, and 1:>99 until the material solubilized in the THFA. The temperature was not controlled in the experiment, and was assumed to be 25°C.

B. WATER SOLUBILITY IN THFA/ACTIVE MATERIAL MIXTURE

This part of the experiment was designed to measure the coupling ability of the THFA. The solution of maximum solubility in part A was used for this experiment. For mixtures greater than a 1:10 ratio, enough THFA was added to bring the solution to a 10% mixture (11 g total), so as to have enough material for this experiment and part C. For mixtures of 1:19, 1:99, and 1:>99 ratios, 10 g of each solution, as is, were used for this experiment.

The 10 g were placed in a stirred vial. Water was added in increments of 0.25 ml to the mixture. The solution was visually inspected to determine the quantity of water necessary to initiate precipitation of the active ingredient and the volume of water was recorded for each mixture.

C. THFA/ACTIVE MIXTURE SOLUBILITY IN 1:100 RATIO WITH WATER

This part of the experiment was designed to determine the coupling ability of THFA in a common commercial dilution ratio (1:100) with water. The mixtures used in part B were also used in this experiment. One gram of the mixture was slowly added with a micropipette to 100 g (or 100 ml) of water. At the first sign of precipitation, the solution was stirred and

TABLE 3
Materials Used In Test

Class	Material name
Acetalmide/anilide	Butachlor
	Propachlor
	Propanil
Arsenicals	MSMA
Benzothiazole	Benuzon (Basagran)
Carbamate	Carboxin
	Carbofuran (Furadan)
Carbamates/thiocarb	Butylate
	EPTC
	Molinate
	Triallate
Chloracetanilide	Metolachlor
Chlorinated HC	Endosulfan
Dinitroaniline	Pendimethalin
Diphenyl ether	Diclofop-methyl (Hoelon)
Halogenated phenols	PCP (Pentachlomphenol)
Halogenated acid/derivatives	Chloramben (Amiben)
	DCPA (Dacthal)
Miscellaneous	Triadimefon (Bayleton)
	Iprodione (Rovral)
	Etridiazole (Terrazole)
Nitrogen compounds	Bromoxynil
	Maleic hydrazide
Phenoxy acids/derivatives	2,4-DB
	MCPA
Phosphate	Isofenphos
	Isazophos (Miral)
	Naled
	Phenamiphos
Pyrethroid	Allethrin
Pyridazinone	Norflurazon (Zorial)
Quaternary ammonia	Diquat
Repellents	Deet
	MGK-R-11
Thiocarbamates	Benomyl
	Maneb
	Zineb
Thiophosphates	Diazinon
	Dimethoate
	Disulfoton
	Fonofos (Dyfonate)
	Azinphos-methyl (Guthion)
Triazines	Malathion
	Atrazine
	Cyanazine
	Prometon
	Simazine
Triazole	Propiconazole (Tilt)
Urea derivatives	Bromacil
	Diuron
	Fluometuron
	Terbacil

TABLE 4
Solubility (High) of Various Materials in Tetrahydrofurfuryl Alcohol (25°C)

1:1 Ratio		1:3 Ratio	
Allethrin	Isazophos	Azinphos-methyl	MCPA
Butachlor	Isofenphos	Bentazon	PCP
Butylate	MGK-R-11	Bromoxynil	Pendimethalin
Deet	Malathion	Chloramben	Propachlor
Diazinon	Metolachlor	Diclofop-methyl	Propanil
Dimethoate	Molinate	EPTC	Propiconazole
Disulfoton	Naled	Endosulfan	Triadimefon
Etridiazole	Phenamiphos		
Fonofos	Triallate		

Note: Ratio, active to THFA.

TABLE 5
Solubility (Low) of Various Materials in Tetrahydrofurfuryl Alcohol (25°C)

1:9 Ratio	1:19 Ratio	1:99 Ratio	1:>99 Ratio
2,4-DB	Diuron	Atrazine	Benomyl
Bromacil	Iprodione	Carbofuran	DCPA
Carboxin		Fluometuron	Diquat
Cyanazine		Norflurazon	MSMA
Maneb		Prometon	Maleic hydrazide
Terbacil			Simazine
			Zineb

Note: Ratio, active to THFA.

reevaluated. This procedure was repeated until the mixture either went into solution or formed on obvious precipitant.

III. RESULTS AND DISCUSSION

A. THFA/ACTIVE MATERIAL SOLUBILITY

The results of the solubility of various active materials with THFA are shown in Tables 4 and 5. The results show the excellent solubility performance of THFA, with over 60% of the materials tested exhibiting high solubility. In general, phosphates, thiophosphates, carbamates, and acetamides exhibited high solubility with THFA. Thiocarbamates, triazines, and urea derivatives evidenced a lower affinity to dissolve in THFA.

B. WATER SOLUBILITY IN THFA/ACTIVE MATERIAL MIXTURE

For our experiment, we chose active materials which have a low solubility in water.[4] From part A, we know that the binary system of THFA and active material will show a high degree of solubility. From a practical standpoint, this can be and has been, used as an acceptable spray mixture for ULV applications. However, a much better mixture may be formed by diluting the binary system with water. Parts B and C of this experiment are attempts to understand and quantify this ternary system.

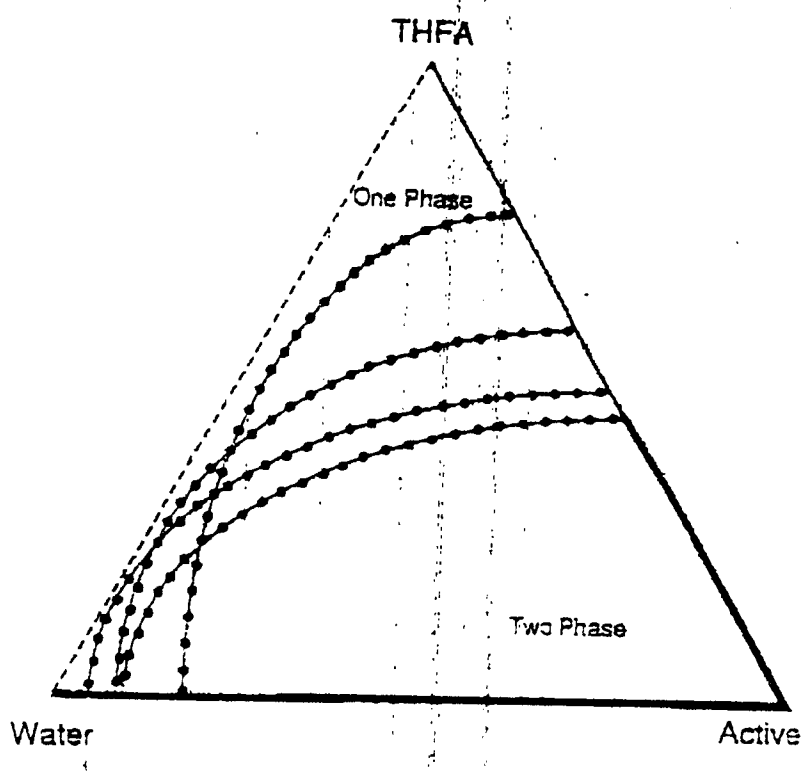

FIGURE 3. Part A — solubility curves of three components.

In order to understand what our experiment is revealing, we must first review what our system looks like by constructing a triangular phase diagram (Figure 3). In this figure, we know that THFA and water are soluble in all portions (denoted by dashes), and that water and active materials are insoluble in portions containing less than 99% water (denoted by thick solid lines). From part A, we determined that blends of THFA and active materials are soluble in varying proportions, depending on the active material chosen (denoted by the thin solid line). The key unknown in this experiment is that we have no information on what shape the solubility curve will take in the interior of the triangle (denoted by the dotted lines).

In Part B of the experiment, we are adding water to the mixture. Figure 4 shows how the addition of water changes the concentration so that the concentration at any point in time will exist somewhat along the tie line drawn in the figure. Saturation of the mixture and precipitation will occur if the tie line intersects the solubility curve. In this experiment, we are testing only one binary concentration of THFA/active material. One could reproduce a portion of this curve by selecting a number of initial starting concentrations and plotting the saturation points on the diagram after the addition of water. Part C of the experiment concerns the area outlined in Figure 5. This area was tested to determine if precipitation would occur in a commonly used dilution ratio (1:100). In addition, it can provide some information about the back side of the solubility curve. A given mixture of the three substances may have a very unique curve that allows two areas of complete solubility (as shown in Figure 4, lower tie line), one at low water concentrations and one at higher water concentrations.

The results of a portion of part B of the experiment are shown in Table 6. These results show that the addition of THFA will couple the active material up to a certain point. THFA

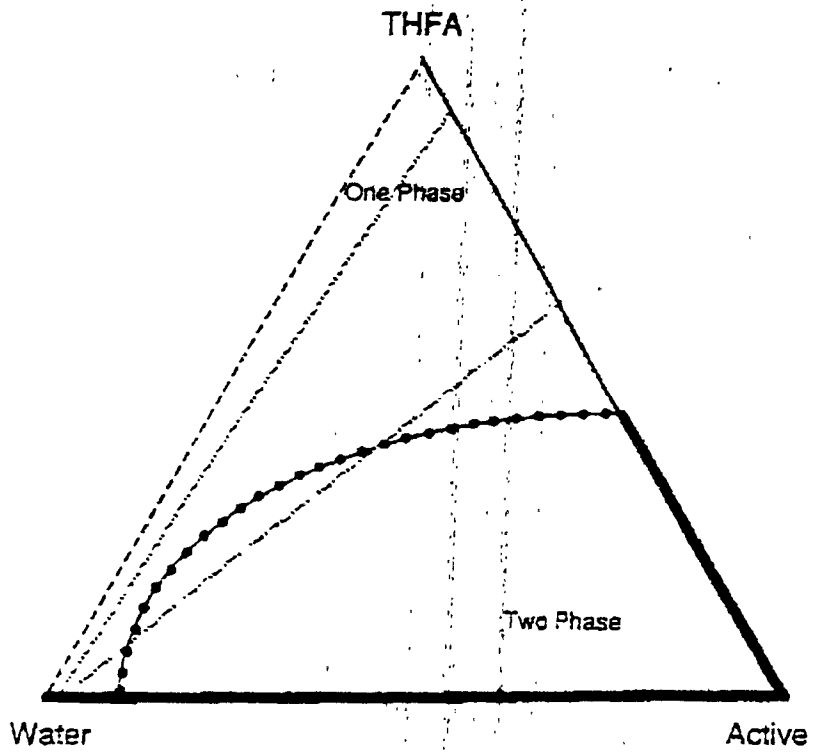

FIGURE 4. Part B — tie lines–water addition to THFA/active mixture.

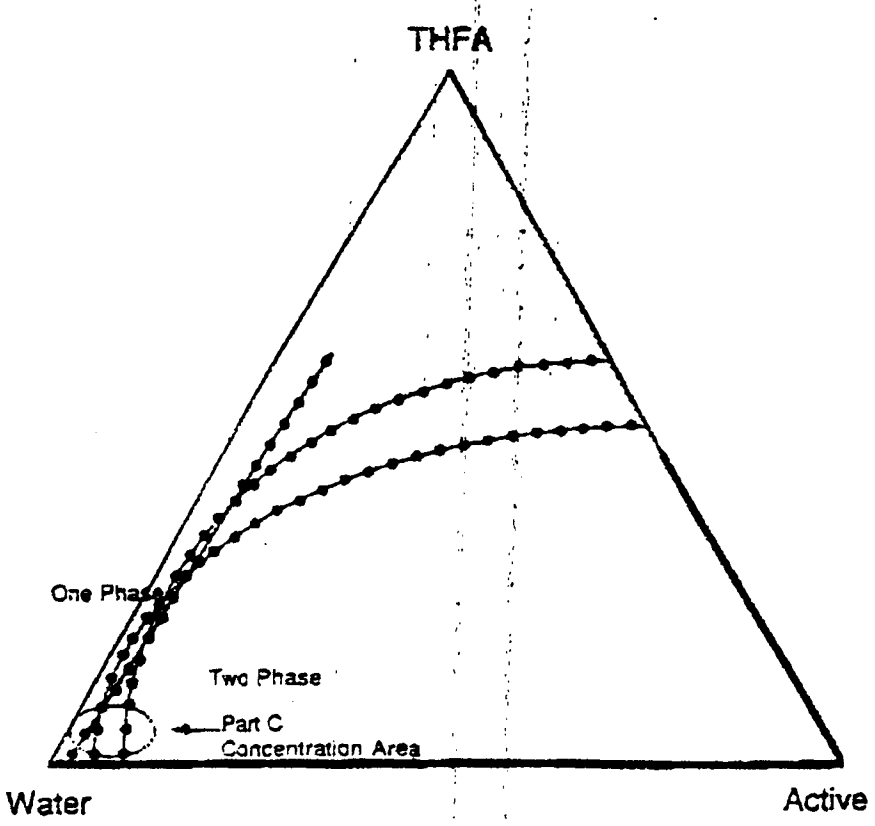

FIGURE 5. Part C — solubility of mixture in 1:100 dilution.

TABLE 6
Solubility of Water in THFA/Active Mixture

Chemical name	Active solution (%)	Water solubility (water:mixture)
2,4-DB	10	3:10
Atrazine	1	Soluble
Azinphos-methyl	10	7:10
Bentazon	10	Soluble
Bromacil	10	3.25:10
Bromoxynil	10	4.25:10
Butachlor	10	8.25:10
Butylate	10	3:10
Carbofuran	1	6:10
Carboxin	10	8:10
Chloramben	10	Soluble
Cyanazine	10	3:10
DCPA	<1	3.75:10
Deet	10	10:10
Diazinon	10	2.25:10
Diclofop-methyl	10	4:10
Disulfoton	10	4:10
Diuron	5	5:10
EPTC	10	5:10
Endosulfan	10	5:10
Etridiazole	10	5:10
Fluometuron	1	6:10
Fonofos	10	5:10
Iprodione	5	3.75:10
Isazophos	10	6.75:10
Isofenphos	10	5.5.10
MCPA	10	10:10
MGK-R-11	10	5:10
Malathion	10	6.5:10
Metolachlor	10	2.75:10
Molinate	10	6:10
Naled	10	10:10
Norflurazon	1	5.5:10
PCP	10	9:10
Pendimethalin	10	2.5:10
Phenamiphos	10	7.25:10
Prometon	1	5:10
Propachlor	10	4.75:10
Propanil	10	10:10
Propiconazole	10	5:10
Terbacil	10	4:10
Triadimefon	10	9:10
Triallate	10	5:10

appears to do well in having some coupling effect on the broad range of substances tested. An interesting experiment beyond the scope of this study would be to continue the addition of water to determine if, and at what concentration, the material would resolubilize, and whether this new concentration would be optimal for commercial applications.

C. THFA/ACTIVE MIXTURE SOLUBILITY IN 1:100 RATIO IN WATER

As discussed, a point was picked to determine whether THFA would couple the active ingredient in a large dilution of water. Table 7 shows a compilation of the materials that

TABLE 7
THFA/Active Mixture Solubility in 1:100 Ratio with Water

Chemical	Mix concentration active:THFA	Water solubility of active
Soluble		
Allethrin	1:10	Insoluble
Atrazine	1:99	33 ppm
Bromacil	1:10	815 ppm
Carbofuran	1:99	700 ppm
Deet	1:10	Insoluble
Diuron	1:19	42 ppm
Fluometuron	1:99	90 ppm
Naled	1:10	Insoluble
Prometon	1:99	620 ppm
Partially soluble		
Benomyl	1:>99	Insoluble
Bentazon	1:10	Insoluble
Chloramben	1:10	700 ppm

were solubilized. THFA appears to be somewhat effective in getting some of the materials to solubilize in water. As previously discussed, it would be interesting to generate solubility curves for the materials in order to determine an optimal concentration for commercial use.

IV. CONCLUSIONS

The results of this study show that:

1. THFA has some unique characteristics which may be of interest to the manufacturer or formulator.
2. THFA alone has good solubility performance with many common active materials.
3. THFA can couple these materials into water; however, three-component equilibrium solubility diagrams should be constructed to determine optimal concentrations for commercial use.

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Topical Application of Penetration Enhancers to the Skin of Nude Mice: a Histopathological Study

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Abstract—Eighteen potential penetration enhancers, some at concentrations that might be used for that purpose, have been examined to evaluate their irritancy potential on nude mouse skin. A biopsy technique was employed followed by histological examination. Up to 50% glycerol, 10% hydroxyethyl lactamide (HELA), 10% oleyl alcohol, 10% Solketal, 10% glycofurol, 100% tetrahydrofurfuryl alcohol (THFA) and 10% urea induced no discernible change in the histological appearance of the skin whereas 100% dimethyl sulphoxide (DMSO), 100% dimethyl formamide (DMF), 100% *N*-methyl-2-pyrrolidone, 10% Azone, 10% oleic acid, 10% methyl laurate, 10% benzyl alcohol and 10% glycerol formal caused severe skin irritation.

Penetration enhancers are agents that increase the permeability of the skin, which itself is a complex stratified barrier the elements within which are affected by different enhancers. Some alter the composition of the cell content (Montes et al 1967), while others affect the cohesiveness between cells and the composition of the intercellular material (Pinkus 1952) or have a direct effect on the cell membrane (Cooper 1984). Recent studies suggest that a major route of skin penetration is through the intercellular channels. The composition of these has been identified and shown to contain structured lipids which undergo a solid-liquid phase transition around 40°C (Elias et al 1983). It is possible that some penetration enhancers act to disrupt the structure of the intercellular lipids and lower the phase transition temperature, thereby increasing the permeability of skin to more polar compounds. To increase the rate of transfer of lipophilic compounds it is necessary to modify the partitioning characteristics at the stratum corneum-viable tissue interface. This may be possible by combining a penetration enhancer with a cosolvent. Some agents can establish a reservoir in the stratum corneum, which may facilitate the diffusion of a drug (Feldman & Maibach 1974), and others, when penetrating the epidermis, may carry the drug through by acting as a solvent. Many of these agents may act by a combination of the various effects on the skin whilst others may be involved in a direct chemical insult on the skin. The exact mechanism by which most penetration enhancers work, however, is largely unknown.

Investigations of percutaneous absorption include the use of solvents which accelerate the penetration of drugs (Jacob et al 1964; Stoughton & Fritsch 1964; Maibach & Feldmann 1976; Mollgaard & Hoelgaard 1983; Barry et al 1984). However, few commercial products employ such accelerants. This is largely due to the lack of understanding of their mechanism of action and the degree of reversibility of the effects. Also their dermal and systemic toxicities have not been established.

The changes in skin produced by single or repeated applications of many commonly used raw materials contained in medicines and cosmetics have been widely studied (Cejka et al 1970; Delacretaz et al 1971; Ingram & Grasso 1975; Rantuccio et al 1979; Motoyoski 1983); but little effort has been made so far to establish the short and long term effects of penetration enhancers on the skin.

Visual patch test reactions to many penetration enhancers have been reported in the literature (Barry et al 1984), but few investigators have used biopsies to assess skin reactions (Wright & Winer 1966; Nater et al 1977). Visual assessments usually rely mainly on dermal changes and may, therefore, give an incomplete picture. Histological assessment on the other hand enables epidermal changes also to be taken into account.

The purpose of the present study was to measure the skin irritation and/or skin damage produced by application of potential penetration enhancers on the skin of nude mice. Although not an ideal model for human skin, the aim was to use the tissue to establish the relative dermal tolerance of the penetration enhancers which may allow a more accurate and rational choice of enhancers for inclusion in commercial formulations.

Materials and Methods

A variety of penetration enhancers was selected to provide a representative group which may be expected to act by the different mechanisms postulated above. Dimethyl sulphoxide (DMSO), dimethyl formamide (DMF), propylene glycol, glycerol, *N*-methyl-2-pyrrolidone (NM Pyrr), *N,N*-diethyl-*m*-toluamide (DEET), oleic acid, oleyl alcohol, tetrahydrofurfuryl alcohol, glyceryl triacetate and urea were reagent grade and used as received (BDH Chemicals). Azone (Nelson Research), benzyl alcohol BP (Albright & Wilson), glycofurol (Hoffman La Roche), hydroxyethyl lactamide (HELA) methyl laurate (Sigma), Solketal and glycerol formal (Aldrich) were all used as received.

Most compounds were tested as 10% w/v solutions in purified water, but some were tested over a concentration range at which they have been found to be effective absorption enhancers. The test preparations were also gelled with 1% w/w neutralized carbomer (Carbopol 940—neutralized with sodium hydroxide) when possible, to enable

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uniform dispersion of insoluble components. The 1% w/w neutralized carbomer gel was also tested as a control.

Male nude mice MF 1 h. source—Olac (1976) Ltd. an allelic variant of white mice, 4 weeks old and weighing 10 to 22 g (average weight 15 g) were used. The animals were not pretreated in any way before the experiment.

The test compounds were filled into a polyvinyl chloride (PVC) cup coated with polyvinylidine chloride (PVDC) of surface area of 0·8 cm^2 and volume 0·3 cm^3. One cup was fastened to the dorsal side of the animal using Blenderm surgical tape. A few drops of Superglue were used to secure the edge of the cup to the skin. Three animals were exposed to each preparation and were maintained three in a cage with food and water freely available throughout the experiment. The materials were kept in contact with the skin for 24 h.

Immediately after the mice were killed and, unless material had leaked from the cup during 24 h, when the results were not analysed, specimens of the exposed areas and of an adjacent untreated skin area were taken for histological examination. The skin pieces were pinned flat and immediately fixed in neutral formalin for at least 48 h, dehydrated through a graded series of alcohols, treated with antermedia and then embedded in paraffin. Sections of 5 μm thickness were cut from each sample and stained with haematoxylin-eosin for microscope observation. Three sections were selected randomly and examined using a scoring system modified from Ingram & Grasso (1975) (Table 1). The final score was the modul score from at least three animals.

Table 1. Histological assessment method.

Epidermal changes	
A. Epidermal thickening	
2 × normal in places	1
2 × normal generally	2
2-3 × normal in places	3
2-3 × normal generally	4
More than 3 × normal	5
B. Increase in the cell layers of the stratum granulosum	
by 1 cell layer	1
by 2 cell layers	2
by 3 cell layers or more	3
C. Hyperkeratosis	
Mainly loose	1
Mainly severe	2
Half loose half compact	3
Compact	4
Compact severe	5
D. Spongiosis	
Slight	1
Extensive	2
Microvesicle formation	3
Bullae formation	4
E. Intracellular oedema	1
F. Destruction of the epidermis	
Superficial	15
1/4 of sectioned area	18
1/2 of sectioned area	20
3/4 of sectioned area	25
Whole of sectioned area	30
G. Hyperaemia	
Slight (increased blood cell concentration in part of epidermis)	5
Moderate (increased blood cell conentration throughout epidermis	10
Extensive (continuous mass of blood cells in part of epidermis)	15
Dermal changes	
H. Increase in the density and thickness of the collagen bundles	
Slight (an increase in places)	1
Slight to moderate (an increase almost thoughout)	2
Moderate (an increase throughout)	3
Moderate to severe (bundles appear as continuous mass in places)	4
Severe (bundles appear as a continuous mass throughout)	5
I. Fractured collagen	
Slight (fractured in places)	1
Moderate (more than half the layer fractured)	2
Severe (fractured throughout)	3
J. Infiltration of the dermis	
Slight in the upper-most layer (an increase in cell numbers just detectable)	1
Slight diffuse (an increase in cell numbers just detectable)	2
Moderate in the upper-most layer (cell number almost double)	3
Moderate diffuse (cell number almost double)	4
Severe in the upper-most layer (cell numbers more than double)	5
Severe diffuse (cell numbers more than double)	6

Results and Discussion

The results from the experimental skin penetration

FIG. 1. Nude mouse skin, untreated back is adjacent to the treated area showing thin stratum corneum and stratum malpighi. H&E × 12·5.

FIG. 2. Back area treated with 100% DMSO for 24 h under occlusion. The section shows hyperkeratosis marked acanthosis and disorganization of the prickle cell layer, intra-epidermal vesiculation and, severe cell infiltration throughout the dermis and into the epidermis. H&E × 12·5.

FIG. 3. Back area treated with 100% DMF for 24 h under occlusion. The section shows considerable loss of the cells nuclei in the epidermis, slight hyperkeratosis, gross alterations of the collagen fibres and oedema in the dermis together with some cell infiltration all indicating severe disorganization of the skin structures. H&E × 12·5.

FIG. 6. Back area treated with 10% oleic acid for 24 h under occlusion. The section shows compact hyperkeratinized stratum corneum with ulcerative eruptions, hyperplasia and hyperaemia throughout the epidermis and oedema, alterations of the collagen fibres, and inflammation in dermis all indicating severe trauma H&E × 12·5.

FIG. 4. Back area treated with 100% N-methyl-2-pyrrolidone. The photomicrograph demonstrates that the outline of the nuclei of the cells and the cell membranes had been completely lost in the epidermis and show large vesicles erupting on the surface of the epidermis. The collagen bundles in the dermis have become thicker and more dense, and have formed into a continuous mass in places. Ulcers and slight cell infiltration are also seen in the dermis. H&E × 12·5.

FIG. 7. Back area treated with 10% methyl laurate for 24 h under occlusion. The section shows partial compact hyperkeratosis with ulcerative eruptions, hyperplasia and some hyperaemia in the epidermis. Vesicles in the epidermis and dermis, hardening of the collagen bundles, and also oedema and inflammation in the dermis. H&E × 12·5.

FIG. 5. Back area treated with 10% Azone for 24 h under occlusion. The section shows a condensed thick layer of stratum corneum over a crust in which severe hyperaemia may be seen. Extensive cell infiltration particularly in the upper part of the dermis can also be observed. H&E × 12·5.

FIG. 8. Back area treated with 10% benzyl alcohol for 24 h under occlusion. The section shows severe compact hyperkeratosis, acanthosis, spongiosis, intracellular oedema and some ulcerative eruptions in the epidermis. The collagen bundles in the dermis appear slightly fractured, and there is some cell infiltration in the area. H&E × 12·5.

Table 2. Relative irritancy derived from score in Table 1 of various concentrations of the test compounds on the skin of nude mice

Enhancer	Concentration (%)					
	1	10	25	50	75	100
DMSO	—	—	—	3	12	21
DMF	—	—	—	—	—	37
Propylene glycol	—	0	5	11	—	—
Glycerol	—	0	0	0	—	—
N M Pyrr	—	10	—	—	—	37
Azone	9	45	—	—	—	—
DEET	—	11	—	—	—	12
HELA	—	6	—	—	—	—
Oleic acid	—	51	—	—	—	—
Oleyl alcohol	—	6	—	—	—	—
Methyl laurate	—	29	—	—	—	—
Benzyl alcohol	—	22	—	—	—	—
THFA	—	—	—	—	—	10
Glyceryl triacetate	—	5	—	—	—	12
Solketal	—	0	—	—	—	—
Glycofurol	—	4	—	—	—	—
Glycerol formal	—	28	—	—	—	—
Urea	—	0	—	—	—	—

enhancers are summarized in Table 2. The histological score was obtained by adding the sum of the scores for the epidermal features (A–E) to the hyperaemia score (G) and the dermal score (H–J). Where destruction of the epidermis had taken place, the score for this alone (F) was combined with the hyperaemia score (G) and the dermis score (H–J). The histology scores provided a means of comparing the inflammatory effects of the different penetration enhancers. Preparations which scored from 0 to 10 were regarded as not causing undue reactions in the nude mouse skin. Preparations which scored from 11 to 20 caused skin reactions, which alone were not sufficiently extensive to exclude their potential use. Preparations which scored above 21 were considered to cause unacceptably severe damage.

Skin treated with 1% Carbopol gel for 24 h under occlusion showed that the stratum corneum had become loose compared with the untreated control, otherwise this section was no different from the untreated section. Seven of the enhancers: glycerol, HELA, oleyl alcohol, Solketal, glycofurol, THFA and urea, did not cause any significant change in the histology over 24 h at the concentrations tested. When 50% propylene glycol was applied, hypertrophy, dermal inflammation and proliferation stimuli were seen, indicating that at this high concentration an irritant effect may be expected. DEET and glyceryl triacetate also only produced a mild effect on the skin over the concentration range used. The eight remaining enhancers each provided an unacceptable irritant reaction at one of the concentrations tested.

FIG. 9. Back area treated with 10% glycerol formal for 24 h under occlusion. The section shows extensive destruction of the epidermis together with hyperkeratosis, acanthosis and spongiosis. Cell infiltration of the dermis can also be seen. H&E × 12·5.

The histopathological findings for those enhancers are exemplified in Figs 1 to 9. The microscopic appearance of the treated skin was, in general, as follows: in the epidermis, acanthosis accompanied with swelling of the cells or proliferation of the basal cells and hyperkeratination; in the dermis, oedema cell infiltration and alteration of the collagen bundles. With the severe irritants such as glycerol formal, methyl laurate, oleic acid, Azone, *N*-methyl-pyrrolidone and DMF, extensive destruction of the epidermis together with ulcerative eruptions and hyperaemia was seen while the dermis appeared severely thickened and compact after most treatments.

The findings for DMSO, DMF and Azone were of particular interest. The results indicated that DMSO may not be as innocuous on the skin as suggested by Steinberg (1967) and Arno et al (1967). Sections treated with 50, 75 and 100% DMSO showed an increase in the histopathological changes, the 100% DMSO also causing an unacceptably high degree of irritancy. Our results are in good agreement with findings by Wright & Winer (1966). DMF was tested undiluted, and found to completely disrupt the normal structure, thus proving to be far more toxic to nude mouse skin than DMSO.

In our study, Azone was also found to be unacceptably irritant even though Stoughton (1982) reported that it did not cause any local irritations or sensitization on human skin.

Animal models are often used to assess percutaneous penetration and to ascertain how this process may be modified by enhancers. While it is often difficult to extrapolate the results to predict absorption rates in man, rough correlations are possible. Also, it is useful to have an indication of the 'damage potential' of enhancers, however, the animal results must be treated with caution, since some substances which enhance absorption in animals may do so as a result of histological damage which may be absent or less severe in humans.

The results of the present work provided no evidence of erythema, oedema or dryness of the skin (the usual visual signs of skin irritation) nor was there any indication of the chronic effects of treatment with the penetration enhancers examined, but there were indications of the kind of effects and the severity of the pathological changes that could be encountered. The study indicated that most penetration enhancers induced some inflammatory effects on the skin and that those enhancers described in the literature as being the most effective also caused the most severe irritation to nude mouse skin.

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APPENDIX VIII

Toxicology Study Abstracts via NCBI and STNEasy

1: J Pharm Pharmacol 1989 Feb;41(2):118-22 Related Articles, Books

Topical application of penetration enhancers to the skin of nude mice: a histopathological study.

Lashmar UT, Hadgraft J, Thomas N.

The Wellcome Foundation Ltd, Dartford, Kent, UK.

Eighteen potential penetration enhancers, some at concentrations that might be used for that purpose, have been examined to evaluate their irritancy potential on nude mouse skin. A biopsy technique was employed followed by histological examination. Up to 50% glycerol, 10% hydroxyethyl lactamide (HELA), 10% oleyl alcohol, 10% Solketal, 10% glycofurol, 100% tetrahydrofurfuryl alcohol (THFA) and 10% urea induced no discernible change in the histological appearance of the skin whereas 100% dimethyl sulphoxide (DMSO), 100% dimethyl formamide (DMF), 100% N-methyl-2-pyrrolidone, 10% Azone, 10% oleic acid, 10% methyl laurate, 10% benzyl alcohol and 10% glycerol formal caused severe skin irritation.

PMID: 2568419 [PubMed - indexed for MEDLINE]

1: PDA J Pharm Sci Technol 2001 Jan-Feb;55(1):16-23 Related Articles, Books

Comparative hemolytic activity of undiluted organic water-miscible solvents for intravenous and intra-arterial injection.

Mottu F, Stelling MJ, Rufenacht DA, Doelker E.

School of Pharmacy, University of Geneva, Switzerland.

In humans, nonaqueous solvents are administered intravascularly in two kinds of situations. They have been used in subcutaneous or intramuscular pharmaceutical formulations to dissolve water-insoluble drugs. The need for these vehicles had increased in recent years, since the drug development process has yielded many poorly water-soluble drugs. The use of water-miscible nonaqueous solvents in therefore one of the approaches for administering these products as reference solutions useful in formulation bioequivalence studies. The intravascular use of organic solvents has also gained importance owing to a new approach for the treatment of cerebral malformations using precipitating polymers dissolved in water-miscible organic solvents. At present, the solvent most commonly used for the liquid embolics to solubilize the polymers is dimethyl sulfoxide, which exhibits some local and hemodynamic toxicities. In order to find new, less toxic vehicles for pharmaceutical formulations for the intravenous and intra-arterial routes and for embolic materials, 13 water-miscible organic solvents currently used (diluted with water) for pharmaceutical applications, were evaluated in this study. Their hemolytic activity and the morphological changes induced when mixed with blood (1:99, 5:95, 10:90 solvent:blood) were estimated in vitro. From these data, the selected organic solvents could be subdivided into four groups depending on their hemolytic activity: very highly hemolytic solvents (ethyl lactate, dimethyl sulfoxide), highly hemolytic solvents (polyethylene glycol 200, acetone), moderately hemolytic solvents (tetrahydrofurfuryl alcohol, N-methyl-2-pyrrolidone, glycerol formal, ethanol, Solketal, glycofurol) and solvents with low hemolytic activity (propylene glycol, dimethyl isosorbide, diglyme).

PMID: 11212416 [PubMed - indexed for MEDLINE]

Organic solvents for pharmaceutical parenterals and embolic liquids: a review of toxicity data

Mottu F, Laurent A, Rufenacht DA, Doelker E.

School of Pharmacy, University of Geneva, Switzerland.

Non-aqueous solvents have long been used in subcutaneous or intramuscular pharmaceutical formulations to dissolve water-insoluble drugs. In recent years, the need for these vehicles was increased since the drug discovery process has yielded many poorly water-soluble drugs. Besides, preparations containing embolic materials dissolved in undiluted non-aqueous water-miscible solvents have been proposed for the intravascular treatment of aneurysms, arteriovenous malformations, or tumors. These organic solvents, regarded as chemically and biologically inert, may show pharmacological and toxicological effects. Therefore, knowledge of tolerance and activity of non-aqueous solvents is essential before they can be administered, especially when given undiluted. This paper focuses on thirteen organic solvents reported as possible vehicles for injectable products and details toxicological data when they have been administered intravascularly. These solvents can be subdivided into three groups according to their description in the literature either for intravenous pharmaceutical parenterals or for intravascular embolic liquids: well-documented organic solvents (propylene glycol, polyethylene glycols, ethanol), solvents described in specific applications (dimethyl sulfoxide, N-methyl-2-pyrrolidone, glycofurol, Solketal, glycerol formal, acetone), and solvents not reported in intravascular applications but potentially useful (tetrahydrofurfuryl alcohol, diglyme, dimethyl isosorbide, ethyl lactate). This review of the literature shows that toxicity data on intravascular organic solvents are insufficient because they concern solvents diluted with water and because of the lack of comparative evaluation using the same methodologies.

PMID: 11107838 [PubMed - as supplied by publisher]

1: J Bacteriol 2001 Mar;183(6):1954-60

Catalytic and molecular properties of the quinohemoprotein tetrahydrofurfuryl alcohol dehydrogenase from Ralstonia eutropha strain Bo.

Zarnt G, Schrader T, Andreesen JR.

Institut fur Mikrobiologie, Martin-Luther-Universitat Halle-Wittenberg, Halle, Germany.

The quinohemoprotein tetrahydrofurfuryl alcohol dehydrogenase (THFA-DH) from Ralstonia eutropha strain Bo was investigated for its catalytic properties. The apparent k(cat)/K(m) and K(i) values for several substrates were determined using ferricyanide as an artificial electron acceptor. The highest catalytic efficiency was obtained with n-pentanol exhibiting a k(cat)/K(m) value of 788 x 10(4) M(-1) s(-1). The enzyme showed substrate inhibition kinetics for most of the alcohols and aldehydes investigated. A stereoselective oxidation of chiral alcohols with a varying enantiomeric preference was observed. Initial rate studies using ethanol and acetaldehyde as substrates revealed that a ping-pong mechanism can be assumed for in vitro catalysis of THFA-DH. The gene encoding THFA-DH from R. eutropha strain Bo (tfaA) has been cloned and sequenced. The derived amino acid sequence showed an identity of up to 67% to the sequence of various quinoprotein and quinohemoprotein dehydrogenases. A comparison of the deduced sequence with the N-terminal amino acid sequence previously determined by Edman degradation analysis suggested the presence of a signal sequence of 27 residues. The primary structure of TfaA indicated that the protein has a tertiary structure quite similar to those of other quinoprotein dehydrogenases.

PMID: 11222593 [PubMed - indexed for MEDLINE]

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Find documents citing this reference [$2.00]

Title

Comparison of the cyclic ether-alcohol tetrahydrofurfuryl alcohol to other known solvents

Author

Doyel, K. J.; McKillip, W. J.; Shin, C. C.; Rickard, D. A.

Organization

QO Chem. Inc., West Lafayette, IN, USA

Publication Source

Adjuvants Agrichem. (1992), 225-34. Editor(s): Foy, Chester L. Publisher: CRC, Boca Raton, Fla.

Identifier-CODEN

58PBAT

Abstract

Tetrahydrofurfuryl alc. (THFA), as an agrochem. adjuvant has seen limited com. applications. THFA's underexploited status is believed due to a lack of publicly available data regarding its characteristics. Inherently low **toxicity**, low volatility, biodegradability, and high solvency in both org. and aq. systems make THFA an attractive candidate for use with agrochems. Studies were performed to characterize the chem. with respect to the utility of THFA in agrochem. adjuvant applications. The results are discussed in comparison to other widely used solvents and carriers. The data presented should provide formulators with another option when selecting formulation chem. for current or exptl. active ingredients.

Document Type

Conference

Language

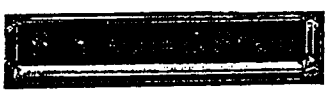
English

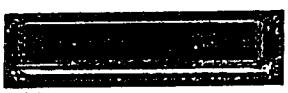
Accession Number

1993:54322 CAPLUS

Document Number

118:54322





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Find documents citing this reference [$2.00]

Title

Solvents for use in topical applications of insecticides

Author

Harris, E. G.; Hadaway, A. B.

Organization

Cent. Overseas Pest Res., London, W8 5SJ, Engl.

Publication Source

Misc. Rep. - Cent. Overseas Pest Res. (U. K.) (1979), 50, 3 pp.

Identifier-CODEN

CPRMBD

ISSN

0307-9058

Abstract

The **toxicity** of ketones to the housefly (Musca domestica) increased with the increasing no. of C atoms from 3 in acetone [67-64-1] to 9 in di-iso-Bu ketone [108-83-8]. Acetone and Me Et ketone [78-93-3] were also the least harmful to the stablefly (Stomoxys calcitrans) and the tsetse fly (Glossina austeni). With the exception of 1,1-diphenylethane [612-00-0], none of 30 solvents tested was **toxic** when applied topically to the housefly at 0.25 .mu.L/insect, but some of the solvents, such as dodecane [112-40-3], was **toxic** at higher doses. Solvent **toxicity** was affected by the application method.

Document Type

Journal

Language

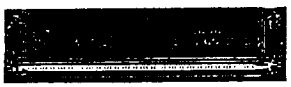
English

Accession Number

1979:552716 CAPLUS

Document Number

91:152716



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Title

Compatibility of organic solvents with the Salmonella/microsome test

Author

Maron, Dorothy; Katzenellenbogen, John; Ames, Bruce N.

Organization

Dep. Biochem., Univ. California, Berkeley, CA, 94720, USA

Publication Source

Mutat. Res. (1981), 88(4), 343-50

Identifier-CODEN

MUREAV

ISSN

0027-5107

Abstract

Fourteen solvents were screened for compatibility with the Salmonella mutagenicity test and 12 were satisfactory under the conditions specified. These 12 solvents were DMSO [67-68-5], glycerol formal [5464-28-8], DMF [68-12-2], formamide [75-12-7], acetonitrile [75-05-8], 95% EtOH [64-17-5], acetone [67-64-1], ethylene glycol di-Me ether [110-71-4], 1-methyl-2-pyrrolidinone [872-50-4], p-dioxane [123-91-1], tetrahydrofurfuryl alc. [97-99-4], and tetrahydrofuran [109-99-9]. The influence of the nutrient broth culture medium on the spontaneous mutation rate of the tester strains is also discussed.

Document Type

Journal

Language

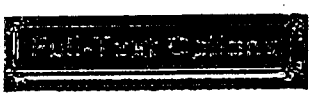
English

Accession Number

1981:169206 CAPLUS

Document Number

94:169206



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Find documents citing this reference [$2.00]

Title

Toxicity of agrochemicals to freshwater organism. CIII. Solvents

Author

Nishiuchi, Yasuhiro

Organization

Noyaku Kenshasho, Japan

Publication Source

Sulsan Zoshoku (1984), 32(2), 115-19

Identifier-CODEN

SUZOAV

ISSN

0371-4217

Abstract

The **toxicity** of solvents used in prepn. of agrochem was tested by detn. of the LC50 (median lethal concn.) of tested solvents on frog (Rana bravipoda porosa) tadpoles. Of 74 solvents tested, MeOH [67-56-1], tetrahydrofurfuryl alc. [97-99-4], acetone [67-64-1], ethylene glycol [107-21-1], ethylene glycol iso-Pr ether [109-59-1], hexylene glycol [107-41-5], diethylene glycol monomethyl ether [111-77-3], triethylene glycol [112-27-6], triethylene glycol monoethyl ether [112-50-5], tetraethylene glycol [112-60-7], dipropylene glycol [25265-71-8], dipropylene glycol monomethyl ether [20324-32-7], trimethylene glycol [504-63-2], 1,4-butanediol [110-63-4], and 1,2,6-hexanetriol [106-69-4] all showed very low **toxicity** to tested frog tadpoles with LC50 of >10,000 ppm, suggesting the usefulness of these solvents as solvents used in **toxicity** test.

Document Type

Journal

Language

Japanese

Accession Number

1986:547635 CAPLUS

Document Number

105:147635

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Find documents citing this reference [$2.00]

Title

Data for hygienic substantiation of standard levels of tetrahydrofurfuryl alcohol in waters

Author

Pozdnyakova, A. G.

Publication Source

Gig. Sanit. (1967), 32(2), 99-101

Identifier-CODEN

GISAAA

Abstract

The odor of tetrahydrofurfuryl alc. (I) is detectable at 8.6 mg./l. At 1 mg./l., I does not affect biochem. oxidn. This is the recommended max. concn. Daily doses of 5 mg./kg. for 4 months did not produce any observed effects in rats, rabbits, and mice. At 10 mg./kg. conditioned reflexes were affected and 20 mg./kg. affected cholinesterase activities, prothrombin times, liver glycogen concns., and rates of immunization.

Document Type

Journal

Language

Russian

Accession Number

1967:98377 CAPLUS

Document Number

66:98377

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ANSWER 3 © 2001 ACS

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Title

Toxicity tests in cell cultures for the purpose of predicting acute **toxicity** (LD50) and reducing the number of animal experiments

Author

Halle, Willi

Organization

Forschungszentrum Juelich G.m.b.H., Juelich, D-52425, Germany

Publication Source

Schr. Forschungszent. Juelich, Lebenswiss./Life Sci. (1998), 1, 1-92

Identifier-CODEN

SFLSF9

ISSN

1433-5549

Publisher

Forschungszentrum Juelich GmbH

Abstract

An in vitro procedure for the redn. of animal expts. for **toxicity** tests of drugs or chems. is presented. Cytotoxicity data from in vitro cultivated mammalian cell lines were compared with acute **toxicity** data to predict the acute **toxicity** effects of xenobiotics in lab. animals. The procedure is based on a comparison of IC50 values (IC50x) with LD50 values using linear regression anal. An enlarged registry (RC) of cytotoxicity is presented contg. cytotoxicity data (IC50x) from non-selected chems. and drugs, the acute oral and i.v. LD50 values (LD50 p.o. and LD50 i.v.) from rats and mice, and the phys.-chem. characteristics of the chems. For the substances of the RC, sorted according to their IC50x-LD50 p.o. pairs, the linear regression parameters were: r = 0.672, intercept a = 0.625, and slope b = 0.435. For the IC50x-LD50 i.v. pairs, the same parameters were: r = 0.768, a = -0.201, and b = 0.480. Approx. 73% of the p.o. values and 78% of the i.v. values are localized in the LD50 dosage range around the regression lines defined by an empirical factor FG.ltoreq.log 5. This percentage factor characterizes the dosage range of LD50 deviating from the regression line by the min. and max. residuals .ltoreq.0.699. The reliability of the predictive procedure was secured by using different biometrical methods and by comparisons of literature results with the data pool in the RC. The allocation of chems. into the 4 **toxicity** classes of acute oral **toxicity** defined by EU regulations (OECD Guide-line 423) resulted an accuracy of 85% in predicting the **toxicity** classes of the RC-substances in comparison to the **toxicity** classes of the corresponding NIOSH LD50 values. A comparison of RC-data with the Acute **Toxic** Class(ATC) method for the classification of chems. into **toxicity** classes resulted in a combined RC-ATC-procedure allowing the redn. of animal nos. for allocating chems. to the EU **toxicity** classes by 30%.

Document Type

Journal

Language

German

Accession Number

1998:666024 CAPLUS

Document Number

129:299139

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ANSWER 4 © 2001 ACS

Find documents citing this reference [$2.00]

Title

Comparison of in vivo and in vitro **toxicity** tests from co-inertia analysis

Author

Devillers, James; Chessel, Daniel

Organization

Centre de Traitement de l'Information Scientifique, Lyons, 69003, Fr.

Publication Source

ACS Symp. Ser. (1995), 589(Computer-Aided Molecular Design), 250-66

Identifier-CODEN

ACSMC8

ISSN

0097-6156

Abstract

Co-inertia anal. is a multivariate method allowing to find the co-structure between two data tables from powerful statistical and graphical tools. It was used to compare **toxicity** results obtained with the rabbit eye test in vivo to those obtained with the in vitro eye organ test.

Document Type

Journal

Language

English

Accession Number

1995:549564 CAPLUS

Document Number

122:284040

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ANSWER 12 © 2001 ACS

Find documents citing this reference [$2.00]

Title

An objective method for the evaluation of eye irritation in vivo

Author

Jacobs, G. A.; Martens, M. A.

Organization

Div. Toxicol., Inst. Hyg. Epidemiol., Brussels, B-1050, Belg.

Publication Source

Food Chem. Toxicol. (1989), 27(4), 255-8

Identifier-CODEN

FCTOD7

ISSN

0278-6915

Abstract

It is generally agreed that intra- and interlab. variations in the evaluation of eye irritants are mainly due to the subjective judgement of eye lesions. The scoring of the palpebral conjunctivae is a typical example. To eliminate these difficulties in assessing eye irritants the relationship between corneal swelling, which can be detd. using an objective technique, and the reading of other symptoms was investigated. The in vivo eye irritation assay was carried out on 34 substances according to the protocol laid down in Annex V, part B of Directive 79/831/EEC of the European Community on the classification, labeling and packaging of dangerous substances. Results were obtained for erythema, edema corneal opacity and corneal swelling. Erythema, edema and opacity were evaluated according to the interpretation rules laid down in Annex VI, part IID of the EEC Directive 83/467/EEC. Corneal swelling was detd. by the ultrasonic pachometer technique. Good correlations were found between the mean percentage corneal swelling after 24, 4, and 72 h and the mean corneal opacity and erythema scores after the same observation times. The corneal swelling scores measured after 24 h using the ultrasonic pachometer are comparable with those reported in the literature, which were obtained by optical pachometry. The good correlation with the other effects scored and the good repeatability of the results opens the possibiliy of introducing an objective and sensitive method into the ocular irritation assay and so reducing intra- and interlab. variations.

Document Type

Journal

Language

English

Accession Number

1989:510541 CAPLUS

Document Number

111:110541

Display without Links | Return to Results

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Display from CAplus (Toxicology focus) database

Previous answer [$3.85] | Next answer [$3.85]

ANSWER 19 © 2001 ACS

Find documents citing this reference [$2.00]

Title

Toxicity monitored with a correlated set of cell culture assays

Author

Borenfreund, Ellen; Shopsis, Charles

Organization

Lab. Anim. Res. Cent., Rockefeller Univ., New York, NY, USA

Publication Source

Air Force Aerosp. Med. Res. Lab., [Tech. Rep.] AFAMRL-TR (U. S.) (1985), AFAMRL-TR-84-002, Proc. Conf. Environ. Toxicol., 1984, 192-201

Identifier-CODEN

AFAAD6

Abstract

Assays for **toxicity** evaluations for chem. utilizing cell cultures were developed and tested; with correlations of tested chem. **toxicities** in the in vivo. Draize rabbit eye irritancy (literature values) and cultured cell tests being good. Cell cultures used were mouse 3T3, hamster CH v79, rabbit cornea, human HepG2, and mouse RAW 264.7 cells. The most **toxic** compds., i.e., benzalkonium chloride, $AgNO_3$, SDS [151-21-3], and NaOCl and the least **toxic**, MeOH [67-56-1], ethylacetone [107-87-9], propylene glycol [57-55-6], and EtOH [64-17-5] were similarly ranked by all the cultured cell **toxicity** tests.

Document Type

Report

Language

English

Accession Number

1986:29904 CAPLUS

Document Number

104:29904

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Previous answer [$3.85] | Next answer [$3.85]

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Display from CAplus (Toxicology focus) database

Previous answer [$3.85] | Next answer [$3.85]

ANSWER 25 © 2001 ACS

Find documents citing this reference [$2.00]

Title

A solvent effect on the mutagenicity of tryptophan-pyrolyzate mutagens in the Salmonella/mammalian microsome assay

Author

Arimoto, Sakae; Nakano, Narumi; Ohara, Yoshiko; Tanaka, Kazumi; Hayatsu, Hikoya

Organization

Fac. Pharm. Sci., Okayama Univ., Okayama, 700, Japan

Publication Source

Mutat. Res. (1982), 102(2), 105-12

Identifier-CODEN

MUREAV

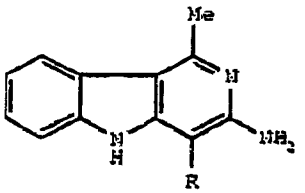
ISSN

0027-5107

Abstract

The effect of adding org. solvents to the preincubation mixt. in the Salmonella/mammalian microsome assay was examd. in tests of 3-amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1)(I) [62450-06-0] and 3-amino-1-methyl-5H-pyrido[4,3-b]indole (Trp-P-2)(II) [62450-07-1]. acetonitrile [75-05-8] Enhanced the mutagenic activity of Trp-P-1 and Trp-P-2 by an order of magnitude under optimal conditions. Strong enhancement of mutagenicity was also obsd. for the addn. of EtOH [64-17-5], MeOH [67-56-1], tetrahydrofurfuryl alc. [97-99-4], THF [109-99-9], 1,2-dimethoxyethane [110-71-4], and DMF [68-12-2]. The enhancing effect of acetonitrile on the mutagenicity of Trp-P-2 was the result of enrichment of the active metabolite in the assay system.

Graphic



I, R=Me

II, R=H

Document Type

Journal

Language

English

Accession Number

1982:594326 CAPLUS

Document Number

97:194326

Display without Links | Return to Results

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Display from CAplus (Toxicology focus) database

Previous answer [$3.85] | Next answer [$3.85]

ANSWER 35 © 2001 ACS

Find documents citing this reference [$2.00]

Title

Survival of fish in 164 herbicides, insecticides, fungicides, wetting agents, and miscellaneous substances

Author

Alabaster, J. S.

Organization

Salmon Freshwater Fish. Lab., Min. Agr., London, Engl.

Publication Source

Int. Pest Contr. (1969), 11(2), 29-35

Identifier-CODEN

IPCWAX

Abstract

Agents (164) including herbicides, fungicides, insecticides other than DDT, sheep dips, DDT, wetting agents, and other compds. were studied for their **toxicity** to Harlequin fish, Rasbora heteromorpha; 24- and 48-hr. median lethal concn. and estd. mean threshold values were worked out by plotting median time of survival vs. logarithm of concn. of the agents. In formulated compds. it was impossible to predict the **toxicity** of the mixt., even knowing the **toxicity** and percent of all components..

Document Type

Journal

Language

English

Accession Number

1969:429549 CAPLUS

Document Number

71:29549

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STN Easy: Display Page

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Previous answer [$1.65] | Next answer [$1.65]

ANSWER 14

Find documents citing this reference [$2.00]

Title
Tetrahydrofurfuryl alcohol.

Author
Anonymous

Publication Source
(1991). Instituto Nacional de Seguridad e Higiene en el Trabajo, Ediciones y Publicaciones, c/Torrelaguna 73, 28027 Madrid, Spain, 1991. 2p.

Document Type
Book; (MONOGRAPH)

Language
Spanish

Entry Month
199809

Abstract
Spanish version of future IPCS ICSC 1159. International Chemical Safety Card. Topics: chemical hazards; data sheet; elimination of spills; explosion hazards; fire fighting; fire hazards; first aid; health hazards; IPCS; irritation; labelling; neurotoxic effects; Spain; storage; waste disposal.

Accession Number
1998:115031 TOXLINE

Document Number
CIS-98-00068

with eScience

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ANSWER 29

Find documents citing this reference [$2.00]

Title
FORENSIC MEDICAL DIAGNOSIS OF INTOXICATIONS WITH TETRA HYDRO FURFURYL ALCOHOL MORPHOLOGICAL CHANGES IN THE INTERNAL ORGANS.

Author
BEREZHNOI R V; SERGEEV S N

Publication Source
SUD-MED EKSPERT, (1979). Vol. 22, No. 1, pp. 49-51.
CODEN: SMEZA5.

Language
Russian

ıtry Month
198103

Abstract
HEEP COPYRIGHT: BIOL ABS. HUMAN AUTOPSY BRAIN HEART LUNG ESOPHAGUS STOMACH KIDNEY ADRENAL

Accession Number
1981:15180 TOXLINE

Document Number
HEEP-81-04231



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Previous answer [$1.65] | Next answer [$1.65]

ANSWER 17

Find documents citing this reference [$2.00]

Title
A QSAR-based biodegradability model: A QSBR.

Author
OKEY R W; STENSEL H D

Organization
Dep. Civil Eng., 3220 Merrill Engineering Build., Univ. Utah, Salt Lake City, UT 84112, USA.

Publication Source
WATER RESEARCH, (1996). Vol. 30, No. 9, pp. 2206-2214.
CODEN: WATRAG.

Language
English

Entry Month
199701

Abstract
 A microbial biodegradability predictive model has been developed using groups