☞ **05hr_SC-NRT_CRule_02-095_pt01**

(FORM UPDATED: 08/11/2010)

WISCONSIN STATE LEGISLATURE ...
PUBLIC HEARING - COMMITTEE RECORDS

2005-06
(session year)

Senate
(Assembly, Senate or Joint)

Committee on Natural Resources and Transportation...

COMMITTEE NOTICES ...

- Committee Reports ... **CR**
- Executive Sessions ... **ES**
- Public Hearings ... **PH**

INFORMATION COLLECTED BY COMMITTEE FOR AND AGAINST PROPOSAL

- Appointments ... **Appt** (w/Record of Comm. Proceedings)
- Clearinghouse Rules ... **CRule** (w/Record of Comm. Proceedings)
- Hearing Records ... bills and resolutions (w/Record of Comm. Proceedings)
  (**ab** = Assembly Bill) (**ar** = Assembly Resolution) (**ajr** = Assembly Joint Resolution)
  (**sb** = Senate Bill) (**sr** = Senate Resolution) (**sjr** = Senate Joint Resolution)
- Miscellaneous ... **Misc**

* Contents organized for archiving by: Stefanie Rose (LRB) (June 2012)

Assembly

Record of Committee Proceedings

Committee on Natural Resources

Clearinghouse Rule 02-095

Relating to groundwater quality standards.
Submitted by Department of Natural Resources.

October 25, 2005 Referred to Committee on Natural Resources.

November 16, 2005 **PUBLIC HEARING HELD**

Present: (12) Representatives Gunderson, Ott, Pettis, Bies, Krawczyk, Petrowski, Mursau, Black, Steinbrink, Van Akkeren, Molepske and Hebl.

Absent: (3) Representatives Moulton, M. Williams and Gronemus.

Appearances For

- Mike Lemcke — Wisconsin Department of Natural Resources

Appearances Against

- Bob Oleson — Wisconsin Corn Growers Association
- Joel Kronenberg — Monsanto Company
- Amy Winters — Croplife America
- Dave Tierney — Monsanto Company
- Ferron Havens — Wisconsin Agribusiness Counsel

Appearances for Information Only

- Mark Werner — Department of Health and Family Services

Registrations For

- None.

Registrations Against

- Laurie Fischer — Dairy Business Association
- John Petty — Wisconsin Agri-Service Association
- Rep. Terry Musser — 92nd Assembly District
- John Exner — Midwest Food Processors Association
- Mike Turner — Wisconsin Fertilizer and Chemical Association

November 16, 2005 **EXECUTIVE SESSION HELD**

Present:	(12)	Representatives Gunderson, Ott, Pettis, Bies, Krawczyk, Petrowski, Mursau, Black, Steinbrink, Van Akkeren, Molepske and Hebl.
Absent:	(3)	Representatives Moulton, M. Williams and Gronemus.

Moved by Representative Gunderson, seconded by Representative Pettis that **Clearinghouse Rule 02-095** be recommended for modifications requested.

Ayes:	(12)	Representatives Gunderson, Ott, Pettis, Bies, Krawczyk, Petrowski, Mursau, Black, Steinbrink, Van Akkeren, Molepske and Hebl.
Noes:	(0)	None.
Absent:	(3)	Representatives Moulton, M. Williams and Gronemus.

MODIFICATIONS REQUESTED RECOMMENDED, Ayes 12, Noes 0

Mike Bruhn
Committee Clerk

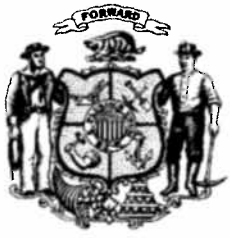
November 16, 2005

MOTION

Moved, that the Assembly Committee on Natural Resources, pursuant to s. 227.19 (4) (b) 2., Stats., requests the Department of Natural Resources to consider modifications to Clearinghouse Rule 02-095, relating to groundwater quality standards, to eliminate the proposed groundwater quality standard for Alachlor-ESA, and to request DNR to commence a scientific review panel to review the proposed groundwater standard for Alachlor-ESA, if Monsanto agrees to pay the full cost of the scientific review panel.

If the Department of Natural Resources does not agree to consider modifications to Clearinghouse Rule 02-095, in a letter addressed to the chair of the Assembly Committee on Natural Resources, or fails to respond in writing to this request for modification, by 5:00 p.m., December 1, 2005, the Assembly Committee on Natural Resources objects to Clearinghouse Rule 02-095 pursuant to s. 227.19 (4) (d) 6., Stats., on the grounds that the proposed rule is arbitrary and capricious, and imposes an undue hardship.

WISCONSIN STATE LEGISLATURE



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June 25, 1999

Steve Karklins
Wisconsin Division of Health
Bureau of Drinking Water and Groundwater
101 South Webster Street
Box 7921
Madison, WI 53707-7921

Dear Steve,

As you know, over the past few months ERG has been coordinating the independent scientific and technical peer review of the draft document entitled "Recommendation for an Enforcement Standard and a Preventive Action Limit for Ammonia in Groundwater." After receiving this draft document from the Wisconsin Department of Natural Resources, ERG reviewed the document and then identified three nationally recognized scientists with the appropriate expertise to serve as peer reviewers. We also discussed any potential conflicts of interest with the peer reviewers, and determined that no conflicts existed. The three reviewers for the draft document are:

Dr. Herbert Cornish
Private Consultant - Formerly of the University of Michigan
830 W. Clark Road
Ypsilanti, MI 48198

Dr. Arthur Gregory
Private Consultant and President - Techto Enterprises
1 Gregory Lane
Luray, VA 22835

Dr. James Withey
Private Consultant - Formerly of Health Canada
49 Wilton Crescent
Ottawa, Ontario K1S-2T6
Canada

Corporate Headquarters:
110 Hartwell Avenue
Lexington, MA 02421-3134
Phone 781-674-7200
Fax 781-674-2851

2200 Wilson Boulevard
Suite 400
Arlington, VA 22201-3324
Phone 703-841-0500
Fax 703-841-1440

14555 Avion Parkway
Suite 200
Chantilly, VA 20151-1102
Phone 703-633-1600
Fax 703-263-7286

900 Perimeter Park (Lab)
P.O. Box 2010
Morrisville, NC 27560-2010
Phone 919-468-7800
Fax 919-468-7803

1600 Perimeter Park (Office)
P.O. Box 2010
Morrisville, NC 27560-2010
Phone 919-468-7800
Fax 919-468-7801

We sent each reviewer a copy of the document to be reviewed, as well as the list of 8 questions to be addressed in the review, which we received from you. These questions were intended as a guide for the consultants in performing their review. In addition, we sent each peer reviewer a conflict of interest certification to sign.

We asked the peer reviewers to provide a written summary of their comments on the document, focusing on the 8 questions. We also instructed the peer reviewers to annotate pages from the draft document, and to include any additional references they may have cited in their review. Attached are the completed peer reviews.

If you have any questions, or require any additional information, please do not hesitate to contact me at 781-674-7323. It has been a pleasure to work with you.

Sincerely,

Heidi Schultz
Coordinator

PEER REVIEW COMMENTS
FROM

HERBERT CORNISH

Nicole Schubert
Peer Review Coordinator
Eastern Research Group
110 Hartwell Avenue
Lexington, MA 02421-3134

June 24,1999

Dear Nicole:
I think I'm going to get this in just before the deadline. I must admit I spent a great deal of time on this document. It's the first document I have reviewed which I think was not very well done.

Their choice for basing their calculation on the dose level for an old medicine did not seem appropriate to me. I have suggested that some of the new data they have reviewed might be more appropriate for setting a standard. You may hear some complaints so I thought I would forewarn you of that possibility.

It's nearing the end of the day and I will just have time to get this off to Federal Express.

Thanks for the opportunity to review this document.

Yours truly,

Herbert H. Cornish, Diplomate American Board of Toxicology

Recommendation for an Enforcement Standard and a Preventive Action Limit for Ammonia in Groundwater

(Draft)

Review

Herbert H. Cornish

June 25,1999

I will begin this review by briefly attempting to comment on the proposed questions, then I would like to make some additional comments.

1. Relevant Toxicity Data

The document presents only a limited review of the information on the toxicity of the ammonium ion. Admittedly there is little basic information available on the toxic response to ammonia. These data are complicated by the fact that ammonia is a natural component of animal metabolism. Thus dose levels and the mode in which ammonia is presented to man or animals affects the biological response. Free ammonia also reacts with water to produce ammonium hydroxide and rapidly reacts with other chemicals that may occur in natural water from various sources. This complexity makes risk assessment difficult and ammonium salts are often utilized in oral studies. There is some concern in the literature on the appropriate salt to be used in such studies since the anion may also affect the results. For example EPA has not accepted animal data utilizing ammonium chloride as a valid study of ammonia toxicity since the chloride ion may produce a metabolic acidosis . It can be argued that as a natural metabolite in animals there are mechanisms to handle readily the effects of both the ammonium and chloride ion and this is apparently true at low dose levels.

2. All Pertinent Data Reviewed

Most of the pertinent animal studies are reviewed and available human data is also presented. Considerable data concerning ammonia which may be relevant to risk assessment are not considered in the document. This includes information on mechanisms of ammonia and chloride toxicity since it is proposed that the use of ammonium chloride in human medicine be used as the basis for risk assessment. There is considerable information in pharmacology and toxicology texts and other relevant information in previous risk assessment documents that would be useful in interpretation of animal and human data on ammonia and its salts.

3. Need For Standard

It is indicated in the present document that new information is available which suggests that the EPA water quality standard might be reviewed. Admittedly the EPA standard is based on taste and odor as an indicator of possible toxic response. This does not appear to be a valid basis for developing safe exposure levels and it appears to have been used because no other good data were available. On the basis of known metabolic sources of ammonia I assume it was concluded that relatively low levels of ingestion could be tolerated. The need for better data is apparent. It is also true, unfortunately, that the proposed use of data based solely on an old traditional use of ammonium chloride as a diuretic and urine acidifying agent has not been documented as a safe level of exposure. No data are presented which would indicate that the medicinal dose was a reasonable LOEL or NOEL. There is only an indication that it has been used medicinally. No short or long term studies in humans or animals are presented to support the conclusion that the human dose is a reasonable LOEL. Admittedly, it may be as good as or better than some of the animal data available. Its use, however is questionable unless the need for a new standard has been documented.

4. Is Database Available

Whether or not there is sufficient appropriate data for calculation of a groundwater standard for ammonia has been the topic of considerable debate over many years. However, where good data are not available it may be necessary to use the best data to suggest an apparent safe

exposure level. This is what has happened with the ammonia level for water. In the absence of data EPA has suggested a level based on organoleptic data. No information has been provided in the present document to suggest whether this is a safe or unsafe level of exposure. Animal studies now reported in this document may provide the best available data for risk assessment .

5. Is the Proposed Standard Based on the Best Available Data.

This is a debatable point since there were no good data available that would be consistent with those normally used in risk assessment calculations. Because of the apparently low order of toxicity of ammonia and the ability of the body to handle ammonia in biochemical reactions EPA suggests the use of taste and odor as a basis for a standard. The present proposal makes use of a level of ammonium chloride utilized in medicine. This would seems a reasonable approach but it makes use of information on ammonium chloride rather than ammonia. Some reports suggest that this is not a suitable chemical to use since the anion may produce biological effects. In addition no data are presented to indicate the basis for the use of this compound in medicine. Certainly the available data are spare, however the present document reviews several recent animal studies that may be useful in risk assessment. See Discussion

6. Use of Uncertainty Factors

A factor of 10 is appropriate to correct for use of a LOEL in general risk assessment calculations.

The factor of 2 to convert from discontinuous exposure to continuous exposure is a judgmental figure and appears to be reasonable.

7. Protection Afforded by the Proposed Standard.

The proposed standard of 9.7 mg/L as ammonia N is obviously more likely to protect sensitive individuals (i.e. infants , those with chronic disease affecting liver or kidney function, those with debilitating illnesses such as cancer) than is the higher level of 34 mg/L of ammonia suggested by EPA. However, there are no data available to suggest that even the proposed lower level of exposure will protect such sensitive individuals. Neither of the proposed values are based on good animal or human studies.

8. Actions Supported by the Available Data.

Ammonia should be regulated with a health based standard derived from animal or human data obtained from good toxicological studies. Some studies are presented in the document which may be useful for risk assessment. By default, both EPA and the present document make use of minimal data in their proposed risk assessments for ammonia. It is not possible to determine which may be the most appropriate since both have serious deficiencies.

DISCUSSION

The discussion of which studies of ammonia are suitable for risk is almost a philosophical discussion rather than a scientific one.

The first question is whether or not there is a necessity for a new standard. The document suggests that "there is ample evidence that chronic exposure to ammonia in water can

contribute to the occurrence of disease and the exacerbation of existing illness in sensitive populations". Although several new studies are reported which appear to provide some suitable data they were evidently not considered suitable for risk assessment calculations. The document does state, however, that two of the studies were best suited for use in identifying a level at which to set an enforcement standard. However the final decision was made to base the standard on ammonia by using the data from a proposed dose schedule for ammonium chloride as a diuretic in children. Unfortunately this dose level was not supported by any data, animal or human, to validate that this is a safe level of exposure.

Often side effects of drugs are tolerated if the compound performs a useful function. As previously mentioned, EPA has suggested that data from studies with ammonium chloride not be used for risk assessment of ammonia because of the acidification provided by the chloride ion which may interfere with the response.

Thus we are faced with a dilemma. The EPA standard is based on taste and odor data while the proposed calculation is based on medicinal use of ammonium chloride in humans but no knowledge of whether it was either effective or safe at the proposed dose level.

On page six of the document it is stated that there is ample evidence that chronic exposure to ammonia in water can contribute to the occurrence of disease and the exacerbation of existing illness in sensitive populations. A review of these data (Kawano or Hata studies) suggest that they may be better suited for the calculation of an enforcement standard than either organoleptic data or undocumented medicinal use. Both of these studies use ammonia in water as the test solution. The Kawano study utilized a two or four week dosing schedule and reported reductions in mucosal thickness at two different dose levels. The Hata study examined the direct effect of ammonia in water on gastric mucosa and reported significant reduction of the fundic and pyloric glands of the gastric mucosa after 8 and 24 weeks of exposure. Both of these studies show effects at several dose levels. The Hata data are provided by a relatively long study which demonstrates a definite effect of ammonia in water after eight or twenty-four weeks of treatment.
These two studies in rats are uncomplicated by the use of an additional anion.

I would suggest that both of these studies be reviewed in detail and considered for possible use In development of an enforcement standard for ammonia.

PEER REVIEW COMMENTS
FROM

ARTHUR GREGORY

Arthur R. Gregory, PhD, DABT

Peer Review
of
Draft Document Entitled
"Recommendation for an Enforcement Standard and a Preventive Action Limit for Ammonia in Groundwater"
(ERG Task No. 0023-192, under
State of Wisconsin Purchase Order No. NMT00001718)

Summary of Peer Review

The major problem with this document is the lack of distinction between the terms "ammonia" and "ammonium hydroxide". The introduction states, "Ammonia commonly reacts with water to form the ammonium ion (NH_4+), and environmental ammonia is usually found with these two forms in dynamic pH-dependent equilibrium." This is totally inadequate. The ATSDR document should be consulted for a better presentation of the equilibrium and the conditions under which it moves in one direction or the other. The dissociation constant (pKa of 9.3) is such that in the pH range of blood, the NH4+ ion constitutes about 99% of the total NH_4+ and NH_3 (Goodman and Gilman, 1990).

On Pages 3 and 4, there is a lack of consistency. On Page 3, background levels are given as 1-3 ppb. On Page 4, the background levels are given as 1-5 ppm, both using the same reference.

On Page 6, subchronic studies were described under the heading of "Chronic Studies."

Lastly, ammonia is both combustible and explosive (see ATSDR and "Encyclopedia of Occupational Health and Safety"). The second paragraph on Page 5 should be revised accordingly.

The Rettig study should be amplified. These data are important justifications for the need for a standard and indicate increased usage of ammonia.

On Page 4, the value for the mean blood ammonia concentration for adults of 70 micrograms per deciliter should not be given as if this were the only true mean value ever reported in the literature. The mean values reported vary with age, sex and analytical methodology. For example, the Geigy Scientific Tables (1984) report values that vary from 0.29 to 1.02 mg/L, depending on age, sex and analytical methodology.

I will now address each of the eight questions specifically asked regarding this draft document.

1. Does the background document present a good overview of the most recent relevant toxicity studies for ammonia in food or water?

This draft document presents a reasonable overview of the most recent relevant toxicity studies for ammonia in food and water. There is not a great deal of data available, but those studies reviewed present a valid picture of our present knowledge on ammonia.

2. Are you aware of toxicity information for ammonia that is relevant to this risk assessment that was not considered?

The studies utilized are the best that are presently available.

3. Does the toxicity information provided in the background document support the need for a health-based standard for ammonia in groundwater that is used to supply drinking water?

It is my opinion that it does. Although there are drawbacks in each of the studies, they support both the dose-response and the direct effects of ammonia in the risk determination paradigm.

I do feel that the use of the term "ammonia in groundwater" is a mistake. Nearly all the ammonia dissolved in groundwater is present as ammonium hydroxide. There is no way that the effects seen can be attributed to ammonia rather than ammonium hydroxide.

4. Is the existing toxicity database for ammonia sufficient to allow calculation of a groundwater standard that will ensure the safety of public and private drinking water supplies?

Ideally, while I would rather see a much sounder toxicity database utilizing larger animal groups and additional species, I consider the present database sufficient for calculations of a groundwater standard.

5. Is the proposed standard based on the most appropriate toxicity information available?

I am not aware of any data that is more extensive or more valuable than the data presented.

6. The proposed standard was established using a composite uncertainty factor of 20 based on the following considerations:

- a factor of 10 was used to account for the use of a lowest observed effect level (LOEL) rather than a no observed effect level (NOEL);
- A factor of 2 was used to account for the use of a recommendation for discontinuous exposure in developing a standard for continuous exposure to ammonia in water.

Are these uncertainty factors appropriate?

The terms should be LOAEL and NOAEL, not LOEL and NOEL, but the uncertainty factors used are similar to those used in most risk estimates. It is always a judgment call as to how we can be "safe enough" without extrapolating beyond reason. I consider the uncertainty factors appropriate. A factor of 10 should be used for extrapolation from experimental animals to humans if the animal studies are to be used.

On Page 10, no reference is provided for the value of 25 mg of ammonium chloride/Kg/day for children. Goodman and Gilman (1990) state only that ammonium chloride is available as an injection or tablets. On Page 695 they further state: "No effort is made herein to detail the specific therapy . . . ."

If the therapeutic guidance is to be used, an explicit reference should be provided to justify the use of 25 mg ammonium/Kg/day as an LOAEL. However, in my opinion the animal studies are more valid and should be used together with a factor of 10 to derive the standard.

7. Is the proposed standard (9.7 mg/L as N) likely to protect sensitive individuals (i.e., infants, those with chronic diseases affecting liver and kidney function, those with debilitating illnesses such as cancer) from toxicity due to ammonia-contaminated drinking water?

It is my opinion that the proposed standard will protect sensitive individuals if a factor of 10 is used in extrapolating from animals to humans and the animal studies are used to drive the standard. I do not consider the therapeutic guidance approach as valid. The reason for this is that the therapeutic guidance approach is based on the substance ammonium chloride, and *this* guidance is based on the acidic nature of the substance rather than the effect of the ammonium ion. On the other hand, the animal studies utilized ammonia dissolved in water and this risk is directly applicable to regulating the amount of ammonia that should be allowed to enter groundwater.

8. Which of the following actions is best supported by the toxicity studies presented?

- ✓ Ammonia should be regulated with a health-based standard derived from data such as those presented in the background document;
- ___ Ammonia should be regulated with a health-based standard derived from the taste/odor threshold;
- ___ Ammonia should be regulate so that the nitrogen burden from nitrate and ammonia not exceed the current standard for nitrate (10 mg/L nitrate-N + ammonia-N);
- ___ Ammonia should be regulated as a nuisance groundwater contaminant based on its taste/order threshold;
- ___ No regulation is needed for ammonia

The increased usage of ammonia direct injection into soils for fertilization should provide impetus for such regulation. This usage doubled in the last year alone (Riley, EPA). While such usage generally results in rapid conversion to nitrate, runoff from overloaded soils having low microbial counts could enter the groundwater. While such intrusion into municipal supplies would probably be diluted to a non-effect level, this may not be the case for groundwater supplying wells of individuals living in the country. Therefore, I consider the proposed regulation of value in protecting the health of the rural community.

PEER REVIEW COMMENTS
FROM

JAMES WITHEY

REVIEW OF DRAFT ' RECOMMENDATION FOR ENFORCEMENT STANDARD AND A PREVENTATIVE ACTION LIMIT FOR AMMONIA IN GROUNDWATER' APRIL 1999.

GENERAL COMMENTS.

I am a little unhappy about this document. After reviewing all of the published scientific literacture on the toxicology of ammonia and ammonium, No chronic studies using the oral or inhalation route were found.(All of those reviewed on pages 6, 7 and 8 are SUB-CHRONIC and should be placed in section 4.2).

The Enforcement Standard is based on information that appears to have no scientific basis! In fact there is no citation for the origin of ' 25mg/kg/day ' as the intermittent therapeutic dose. The Canadian Compendium of Pharmaceuticals and Specialties (1987) recommends ' 4 to 12g daily in divided doses every 4 to 6 hours ' which, for a 75kg man, works out at 160mg/kg/day. Although this is not the most recent copy of the Compendium, I have checked with the Canadian Health Protection Branch and the entry has not changed. I enclose a copy of the entry.

PAGE BY PAGE REVIEW.

Page 2, line 5. Give some indication of what is ment by ' high ' levels of ammonia in air.

Page 2, line 19. Again give some indication of what the concentration is in household ammonia. Page 5 has a statement that household ammonia contains 5 to 10% of ammonia.

Page 3, line 2. If the nitrification process yields nitrite and nitrate then the leached sediments may also contain nitrites well as nitrates.

Page 3, lines 2 to 4. I think you should explain the production of nitrogen in the absence of oxygen in a little more detail.

Page 3, line 20. What is ' photoelectric ' activity that forms hydroxyl radicals. Isn't the process photolysis?

Page 4, line 15. Note that sensitive sub-group populations are identified here. They are not considered in the development of the enforcement standard. EPA usually uses the uncertainty factor of x 10 for this parameter.

Page 5, line 3 and 4. This is not a dose. The volume and weight of the animals are needed to assess the dose. (More on ' dose ' later).

Page 5, line 9. The ' higher concentrations ' should be given in more informative terms.

Page 5, line 18. In Webster's report, were recoveries observed when one fluid ounce was ingested of 28% ammonia?

Page 6, Beginning line 11. Here, and in other studies cited later, the concentration of ammonia in the drinking water is given as a ' dose '. It is not. If the dose is not given in the publication, the US EPA uses an allometric relationship to obtain the water consumption per day, for a rat of a given weight, and calculates a dose per day. I enclose a reference and some photocopies of pages that allow these calculations from ' Recommendations for and Documentation of Biological Values for use in Risk Assessment' US. EPA/600/6-87/008, February, 1988.

For example, for a 200g rat the water consumption rate per day is calculated from the allometric relationship, given on page 1-11,

$$C = 0.1 \ W^{0.7337}.$$

which works out at 0.04 litres per day and, if the concentration of ammonia is 100mg/litre, comes out to 4mg/day and , if the rat weighs 0.2kg, the dose is 20mg/kg/day.

This procedure should be carried out for the Kawano et al. (1991), Hata et al. (1994), Toth, (1972), Tsujii et al. (1995) studies.

Page 6 . Section 4.3 Chronic Studies. There are no chronic studies in humans or animals. This statement should suffice for this section and all the discussion on pages 6, 7 and 8 should be transposed to section 4.2.

Page 7. Beginning on line 5. The Gupta et al. paper is listed in the reference section and its title is ' Toxicological studies of ammonium sulfate' (not sulfamate). I suspect this is an error in the reference list.

Page 7, line 7. I suppose that ' administered orally ' means ' by intubation '.If this is the case, say so.

Page 7. line 9. A 90 day study in rats is, classically, a sub-chronic study.

Page 7, line 19. The significant reductions in the ' height ' of the fundic and pyloric glands sounds odd. Shouldn't it be ' length '?

Page 7,last line. In the subsequent study by Hata et al. , for how long were the rats given water containing 200mg/litres?

Page 8, line 8. In the Deaton (1984) study, you should say what the route was (inhalation) and what the exposure regimen was.

Page 8, line 13. The study by Toth is the only study for which a chronic exposure was used. It is not clear whether only ammonia was used or whether all animals had been treated with the various hydrazine compounds as well. Please clarify. Also, were other observations than histological examination carried out?

Page 8 .Beginning line 21. In Tsujii's study, how large were the groups?

Page 9, lines 14 and 15. We have no chronic studies (except for a cancer study) available. Therefore this statement is erroneous and should be deleted.

Page 9, line 20. The literature contains data on the oral intake of ammonium compounds, not ammonia.

Page 10. It will be apparent from what has been stated in the General Comments, that I do not like the presentation in the first paragraph. I have pointed out, with referenced material (Canadian Compendium), that other figures for therapeutic doses of ammonium chloride have been recommended. I would like to see a reference as to where the 25mg ammonium/kg/day comes from. Secondly, this substance would not be given to patients suffering from kidney or liver disease i.e. it is not protective for ' special groups at risk' .

(This might be accommodated by using another uncertainty factor of x 10). Given that the therapy is dependent on the patient taking the high dose for only 3 to 4 days and then resting for ' a few days ' is this intermittent exposure accommodated by using an uncertainty factor of only 2 ?

Page 11, line 5. The US. EPA has used an organoleptic effect to set their Lifetime Health Advisory (taste). Was this because the published science was inadequate?

Page 12, line 7. The paper by Tsujii et al. (1995), in a sub-chronic study, certainly did show an interactive capacity for carcinogenesis and ammonia in promoting stomach cancer induced by MNNG.

SPECIFIC QUESTIONS ASKED BY EASTERN RESEARCH.

1.Quality of document. The document presents what little information there is on the toxicology of ammonia. None of these studies were, apparently, suitable for the derivation of an enforcement standard.

2. Are you aware of other toxicity data? No. I have enclosed the Canadian recommendations for therapeutic use of ammonia.

3. Does toxicity data support the need for a drinking water standard? No.Before this could be accomplished a well designed chronic study is desperately needed. Perhaps a human study could be constructed for this purpose.

4. Is toxicity data adequate to allow the development of a ground water standard that will ensure the safety for drinking water supplies?

Definitely not! I don't think we have sufficient data and, even with the application of larger uncertainty factors, we could not be sure that the number would be protective.

5. Is present standard based on the best information available?

For reasons that I have already expressed I think the scientific basis for the standard is extremely poor. If a more rational basis for the selection of the therapeutic dose

recommendations can be provided then we should have the best available information, but this would not beat a new, properly designed chronic study.

6. Appropriateness of the Uncertainty Factor. I don't think they are protective enough. I think that another uncertainty factor for sensitive sub-groups is necessary and we should think about one for the cancer promotion aspect. I am not sure, given the erratic dosage regimen suggested for the therapeutic application, that a factor of 2 is sufficiently protective either.

7. Is the present standard sufficient to protect sensitive groups at risk? Certainly not, for reasons that I have extensively covered in this review.

8.Which of the following actions is best supported by the toxicity studies presented?

..✓.. Ammonia should be regulated with a health- based standard (derived from data such as those presented in the background document) — doubtful.

.....Ammonia should be regulated with a health-based standard derived from the taste/odor threshold;

.....Ammonia should be regulated so that the nitrogen burden from nitrate and ammonia not exceed the current standard for nitrate (10mg/Lnitrate-N+ammonia-N);

.....Ammonia should be regulated as a nuisance groundwater contaminant based on its taste/odor threshold;

.....No regulation is needed for ammonia;

JAMES R. WITHEY, PhD.

June 19 1999.

ANNOTATED PAGES
FROM

JAMES WITHEY

DRAFT

Recommendation for an Enforcement Standard and a Preventive Action Limit for Ammonia in Groundwater

April, 1999

1.0 Introduction

Ammonia (NH_3) is a basic inorganic compound that occurs in the environment as a result of both natural and industrial processes. In nature, ammonia is a key constituent in the nitrogen cycle, the process by which nitrogen becomes available for use in the various biological activities for which it is required. Ammonia commonly reacts with water to form the ammonium ion (NH_4^+), and environmental ammonia is usually found with these two forms in dynamic pH-dependent equilibrium. Concentrated levels of ammonia from natural sources may result from accumulated animal wastes or from sewage treatment plants. Other natural sources include decaying vegetation and volcanic activity.

Commercially, ammonia is used widely as an agricultural fertilizer, as well as in refrigeration systems, household cleaners, and manufacturing processes. It is used in conjunction with chlorine to form chloramine, a common drinking water disinfectant. Concentrated levels of ammonia from commercial sources may commonly stem from the release of anhydrous ammonia to the environment or as effluent from industrial processes in which ammonia is used. The commercial synthesis of ammonia is considered to be a minor source, contributing no more than 5% of the total global ammonia budget.

2.0 Hazard Identification

2.1 Sources of Human Exposure

2.1.1 Inhalation

Ammonia may volatilize into the atmosphere from surface water. Most human exposures to elevated levels of ammonia result from inhalation of ammonia that has volatilized from household cleaning products. Inhalation of anhydrous ammonia may result in a serious, life-threatening inflammation of the respiratory tract, and may lead to the development of chronic bronchitis. Specific populations which may be exposed to high levels of ammonia in air include workers in industries involved in the manufacture or transport of ammonia-containing formulations, agricultural workers exposed to anhydrous ammonia or animal wastes, and people who live near agricultural sites where fertilizers are applied or livestock facilities which generate large amounts of animal waste.

2.1.2 Ingestion

Accidental or suicidal ingestion of household cleaning products may cause severe burns to the mouth, throat, esophagus and stomach. Ammonia evaporates quickly from surface water. In aerobic soil, nitrogen-fixing bacteria rapidly convert ammonia into nitrite (NO_2), which is converted into nitrate (NO_3) under aerobic conditions. Due to this metabolic activity and its volatility, ammonia is not found as a major contaminant of groundwater or surface water.

2.1.3 Dermal

Exposure may occur through dermal contact with household products containing ammonia. Exposure to anhydrous ammonia during the processing or application of fertilizers may result in severe burns to the eyes and skin.

2.2 Environmental Fate

2.2.1 Surface water and groundwater

Upon reaching surface waters, groundwater or sediment, ammonia may be transformed through two processes: nitrification and denitrification. Nitrification is an aerobic

process which yields the ionic compounds NO_2^- and NO_3^-. These may leach through sediment as nitrate or be taken up by aquatic plants. In the absence of oxygen, denitrification may transform ammonia into elemental nitrogen, a gas that is quickly lost to the atmosphere.

Ammonia can be acutely toxic to fish, and can cause symptoms such as loss of equilibrium, hyperexcitability, and increased breathing, cardiac output and oxygen uptake. High ammonia concentrations in water may result in convulsions, coma, and death. For freshwater fish, 48 and 96-hr LC_{50}s in the range of 0.024 to 4.60 mg/L have been reported. Reduced growth rate and pathological tissue changes have been reported at lower levels (WHO, 1986).

Background levels of ammonia in surface water and groundwater are rarely found to exceed 1 mg/L (ATSDR, 1990). Elevated ammonia levels may be found in surface waters near sewage treatment plants or large animal feedlots. In some cases, agricultural wastes may influence the levels of ammonia found in shallow wells. The rapid transformation of ammonia to nitrate is consistent with the observation of low levels of ammonia in groundwater.

2.2.2 Air

For ammonia that volatilizes into the atmosphere, a major transformation mechanism is a rapid reaction with acidic gases to form ammonium particulate. Ammonia may also react with hydroxyl radicals formed as a result of photoelectric activity. The resulting ammonium particulate may return to the earth's surface through wet or dry deposition.

Background worldwide atmospheric levels of ammonia are estimated at 1-3 parts per billion (ATSDR, 1990). Higher levels may be observed in locations near significant sources of ammonia, such as large animal feedlots.

2.2.3 Soil

Ammonia may reach soil through deposition or from the application of fertilizers. Ammonia in the soil is rapidly converted to nitrate or gaseous nitrogen, or may be taken up by plants. Background levels have been estimated at 1-5 parts per million, but are appreciably higher in soils on which fertilizers have been applied (ATSDR, 1990).

3.0 Absorption, Metabolism, Distribution and Excretion

In addition to the contribution from environmental sources, ammonia is produced in the human body as a result of the breakdown of protein, amino acids and other nitrogen-containing compounds by digestive tract bacteria. Ammonia that enters the gastrointestinal tract is rapidly absorbed. The mean blood ammonia concentration for adults is 70 micrograms/deciliter (Diaz, 1995). Absorbed ammonia is transported to the liver where it is converted to two metabolites: glutamine and urea. Glutamine is distributed to the tissues for use as a source of nitrogen for the synthesis of proteins, while urea is excreted by the kidneys. Persons suffering from diseases of the liver or kidneys may metabolize or excrete ammonia inefficiently, and are considered to constitute a sensitive subpopulation with respect to the toxic effects of ammonia. In patients with acute liver failure, ammonia may accumulate in the blood, brain and cerebrospinal fluid causing a condition termed hepatic encephalopathy. Other sensitive subpopulations include persons with genetic defects in ornithine transcarbamylase or the enzymes of the urea cycle, persons suffering from gout, and women in the last trimester of pregnancy who are at risk for toxemia of pregnancy (Dabney, 1996).

4.0 Dose-Response Assessments

4.1 Acute Toxicity

In experiments designed to demonstrate the acute toxicity of ammonia, glycols and other related compounds, Smyth and colleagues (1941) administered ammonium hydroxide in water to albino rats. Administration was by stomach tube in a single dose at concentrations as high as 1%, with 10 animals used per dosage. Animal deaths occurring within two weeks of dose administration were included in the assessment of lethality. An acute LD_{50} was reported at 350 mg/kg.

This is NOT a dose

Household ammonia solutions typically contain 5-10% ammonia in water. These concentrations rarely cause burns, but can irritate the eyes, nose, throat, and upper respiratory tract. Higher concentrations used in agricultural and industrial settings can cause irritation and severe burns of the eyes, lungs, upper airway, and skin. When heated to decomposition, ammonia emits toxic fumes of ammonia and nitrogen oxides. A study of emergency room records from 18 central Nebraska hospitals identified ammonia as the agricultural chemical most frequently associated with emergency room treatment or hospitalization (Rettig, 1987).

such as?

Suicidal or accidental ingestion of household ammonia can cause esophageal burns with late resulting strictures. Gastric, duodenal and jejunal lesions have also been reported. One teaspoonful of strong (28%) ammonia has been reported to be fatal but recoveries have followed ingestion of as much as one fluid ounce on several occasions (Webster, 1930).

of this concentration?

Ingestion of milk contaminated with ammonia from a commercial refrigeration system resulted in acute illness among a group of Wisconsin school children in 1985. Reported symptoms included nausea and burning of the mouth and throat, and were observed within an hour after consuming contaminated milk. Analysis of milk from unopened cartons delivered to the school showed ammonia concentrations ranging from 530 to 1524 mg/L (CDC, 1986).

4.2 Subchronic Toxicity

Ammonium chloride has been used as a diuretic and urine-acidifying agent. Therapeutic dosage levels for adults range from 4 to 12 grams/day. Based on an average body weight of 70 kg, these are equivalent to 19 to 57 mg/kg/day as ammonium. The usual acidifying dose for children if 75 mg/kg/day (25 mg/kg/day as ammonium). The drug is given in four divided doses for three to four days, followed by a two-day rest period. If given continuously, particularly to patients with renal impairment, it may cause severe metabolic acidosis. Any use is contraindicated in patients with liver or renal disease since accumulation of ammonia in such patients may lead to central nervous system toxicity. Other adverse effects associated with the administration of ammonium chloride include gastric irritation, anorexia and electrolyte disturbances (ASHP, 1988). ✓

Kawano and colleagues (1991) investigated the relationship between ingestion of ammonia in water and chronic atrophic gastritis in rats. In this study, groups of rats were given water containing 0.01% ammonia (100 mg/L) or 0.1 % ammonia (1000 mg/L) for either two or four weeks. A separate group of rats was retained as a control. Following exposure, the rats were sacrificed and their stomachs subjected to histological examination. Rats exposed to 0.01% ammonia exhibited significant reduction in the thickness of the antral mucosa in comparison with control rats following four weeks of exposure. Rats exposed to 0.1% ammonia showed significant reductions in mucosal thickness after two and four weeks of exposure, with reductions greater than those seen in the 0.01% exposure group. The authors concluded that ammonia produced by the gastric bacterium *Helicobacter pylori* likely plays a role in the development of chronic atrophic gastritis.

give us the dose calculated mg/kg/day EPA. regulations does this.

4.3 Chronic Studies

The chronic toxicity of ingested ammonia has not been studied in humans. Several subchronic animal studies have been conducted using drinking water or dietary exposure to ammonium hydroxide, ammonium chloride, and ammonium sulfamate. Systemic effects that have been observed include enlarged adrenal glands, alterations in blood pressure, and decreased body weight associated with decreased food intake.

y can't we mentioned 5 previous weight?

Fazekas (1939) conducted a study on the effects of exposure to ammonium hydroxide (NH_4OH) on rabbits. Animals were given 100 mg NH_4OH/kg body weight on alternate days, then on a daily basis for 17 months. Test animals were found to have enlarged adrenal glands and elevated blood pressure.

a 90 day study in rat is not chronic

Gupta and colleagues (1979) conducted an investigation of the chronic toxicity of ammonium sulfamate in adult and weanling albino rats. Ammonium sulfamate was administered orally to groups of 20 rats in dosages of 100, 250 and 500 mg/kg/day, respectively, with another group of rats serving as controls. Doses were administered six days a week for 90 days. Significant decreases in group mean body weight were observed for the 500 mg/kg/day dose group of adult females weighed after 60 days and 90 days. A significant decrease in food consumption was observed in the 500 mg/kg/day dose groups of male and female weanlings after 90 days. No adverse effects relating to animal appearance, behavior or survival or organ histology were observed.

intubation?

? refs say sulfate!

Hata and colleagues (1994) conducted an investigation of the effects of ammonia on gastric mucosa. Groups of 60 male Donryu rats were given drinking water with ammonia concentrations of 200 mg/L and 1000 mg/L, respectively, for 24 weeks, with a third group retained as a control. At eight intervals during the experiment, subgroups of six animals were extracted, sacrificed, and examined for histological changes in the gastric mucosa. Significant reductions in the height of the fundic and pyloric glands were observed in both treatment groups in animals sacrificed after eight and 24 weeks. The authors concluded that these findings are indicative of the direct toxicity of ammonia on the gastric mucosa.

Similar comment for Kawano et al

not chronic

In a subsequent experiment, the same researchers examined the effect of ammonia on the healing of gastric ulcers induced by treatment with acetic acid. Forty six-week-old male Donryu rats were infused with acetic acid by laparotomy to induce gastric ulcer formation. The animals were then divided into two groups: one given water containing 200 mg/L ammonia and one given untreated water. The induction of ulcers by treatment

convert to mg/kg/day

for how long?

with acetic acid was confirmed in all animals. Animals were sacrificed after four and eight weeks and their stomachs examined. Rats fed ammonia in water had ulcers significantly larger than controls after four and eight weeks of treatment, a finding the authors attributed to an impaired ability to repair gastric ulcers in the treatment group.

Not chronic.

4.4 Reproductive and Developmental Effects

Few data exist on the reproductive or developmental effects of ammonia exposure in humans or mammals. Decreased egg production has been demonstrated in birds and pullets exposed to ammonia (Deaton, 1984). An elevated ammonia tissue concentration in cows has been found to decrease conception rates and increase the calving-to-conception intervals (Visek, 1984). No data were located regarding the teratogenic potential of ammonia.

(inhalation) & how exposed how long

how? by the inhalation route

any info on how exposed and for how long

4.5 Carcinogenicity and Mutagenicity

a chronic study!!

Toth (1972) examined the carcinogenicity of ammonia in lifetime studies in mice. Ammonium hydroxide was administered under two sets of conditions: to five-week-old Swiss mice in drinking water at concentrations of 0.1% (1000 mg/L), 0.2% (2000 mg/L) and 0.3% (3000 mg/L); and to seven-week-old C3H mice in drinking water at 0.1% (1000 mg/L). All animals were either allowed to die or euthanized with ether when found in poor condition, and subjected to histological analysis. The incidence of tumors in the treated animals was similar to the incidence in control mice. The authors concluded that ammonium hydroxide does not exert a carcinogenic effect in mice.

convert to mg/kg/day

Tsujii and colleagues (1995) conducted an investigation of the relationship between exposure to ammonia in water and gastric carcinogenesis initiated by treatment with N-methyl-n'-nitrosoguanidine (MNNG). Groups of male Sprague-Dawley rats were given MNNG in drinking water for 24 weeks, after which groups were given either water containing 0.01% ammonia (100 mg/L) or tap water for another 24 weeks. Animals were sacrificed and their stomachs subjected to histological analysis. Rats fed ammonia in the

how many? per group?

mg/kg/day please.

second phase of the experiment had a significantly higher incidence of stomach cancer, had a greater number of stomach tumors, and had tumors that were greater in size than control rats. The authors concluded that ammonia may play a role in the etiology of stomach cancer associated with *Helicobacter pylori*.

There are few data in the literature on the mutagenicity of ammonia. A number of researchers have reported that some evidence of mutagenicity in bacterial cells treated with lethal doses of ammonia. Because of the lethality of the administered dose, however, such findings have generally been interpreted as not indicative of any mutagenic effect (ATSDR, 1990).

4.6 Summary and Rationale

The goal of reviewing the toxicological data described above is to identify those data that provide appropriate guidance for recommending an enforcement standard and preventive action limit for ammonia in groundwater. While the number of studies investigating adverse outcomes relating to oral exposure to ammonia is small, the available data provide ample evidence that chronic exposure to ammonia in water can contribute to the occurrence of disease and the exacerbation of existing illness in sensitive populations. In accordance with the provisions of Chapter 160 Stats., it is therefore appropriate for the Department of Health and Family Services to issue a recommendation for an enforcement standard and a preventive action limit for ammonia in groundwater.

The literature includes a number of animal studies relating oral ammonia intake to a variety of health effects. In three of these studies (Kawano, 1991; Gupta, 1979; Tsujii, 1995), adverse health effects were observed following consumption of water containing ammonia or ammonium sulfamate at concentrations of 100 mg/L. Of these three, the studies by Kawano *et al* and Tsujii *et al* are best suited for use in identifying a level at which to set an enforcement standard. Given that the test animals in the study by Gupta *et al* were exposed to ammonium sulfamate, the lack of definitive information on the

toxicity of sulfamate may make it difficult to attribute the health effects observed in this study solely to exposure to the ammonium cation.

Data on the effects of subchronic or chronic human exposure to ammonia are extremely limited. Information on the use of ammonium chloride as a diuretic agent, however, provides important guidance in identifying an enforcement standard. It is recommended that therapeutic dosages of ammonium chloride not exceed 25 mg ammonium/kg/day for children, and that continuous use at that dose may cause systemic toxicity in patients with liver or kidney disease. As an oral dose considered potentially toxic upon continuous exposure, the maximum therapeutic dose of 25 mg ammonium/mg/day constitutes a lowest-observed adverse-effect level (LOAEL) for ammonia. Given that this recommendation directly relates to chronic human oral exposure to ammonia, this recommendation provides a more direct basis for recommending an enforcement standard than is offered by the studies by Kawano *et al* and Tsujii *et al.* For this reason, the recommendation on the therapeutic use of ammonium chloride is used in deriving the recommended enforcement standard and preventive action limit.

What is 1.875 mg based upon for a 75 kg man

What is effect?

5.0 Recommendation of an Enforcement Standard and a Preventive Action Limit

In Wisconsin, the process by which groundwater enforcement standards and preventive action limits are to be set is specified in Chapter 160 of the Wisconsin Administrative Code. According to Chapter 160 Stats., the Department of Health and Family Services is charged with developing recommendations for enforcement standards on the basis of federal regulations and guidelines, such as the EPA's Maximum Contaminant Levels or Lifetime Health Advisories. The Department may recommend an enforcement standard that differs from a federal recommendation or standard "if there is significant technical information which is scientifically valid and which was not considered when the federal number was established".

The U.S. Environmental Protection Agency (EPA) has not established a health-based drinking water standard for ammonia. The EPA has issued a Lifetime Health Advisory for ammonia at 34 mg/L, which corresponds to the taste threshold for ammonia in water. Based on our review of current literature on the toxicity of ammonia, the Department of Health and Family Services finds that the federal lifetime health advisory may not adequately protect sensitive subpopulations, such as persons suffering from kidney or liver disease, against the toxicity of ingested ammonia.

will the 25mg/kg/day?

Therefore, in accordance with the provisions of Chapter 160 Stats., the Department of Health and Family Services recommends that a health-based groundwater enforcement standard be based on the human toxicity of ammonium chloride which has been used as a therapeutic agent. Following ingestion, ammonium chloride dissociates to produce the chloride anion and the ammonium cation. The chloride anion exerts a diuretic effect, but has little overt toxicity. In Wisconsin, chloride is currently regulated in public drinking water supplies and in groundwater as an indicator parameter. The literature suggests that the gastric irritation and neurotoxicity that have been associated with ingestion of ammonium chloride may be attributed to the local and systemic toxicity of ammonia.

To develop a health-based groundwater standard that will be protective against the toxicity of ingested ammonia, application of an uncertainty factor of 20 to the therapeutic dosage level is recommended. This includes a factor of 10 to convert from a human LOAEL to a NOAEL, and an additional factor of 2 to account for the use of information from a discontinuous, subchronic exposure. In accordance with Chapter 160 Stats., this recommendation is based on a daily intake of 1 L of water for a 10-kg child for whom drinking water constitutes the only source of ammonia exposure.

No consideration of special groups at risk. factor of 2 is not rationale

$$\frac{25 \text{ mg/kg/day} \times 10 \text{ kg}}{20 \times 1 \text{ L/day}} = 12.5 \text{ mg/L as ammonium (9.7 mg/L as ammonia-nitrogen)}$$

In addition to the setting of an enforcement standard, Chapter 160 Stats. calls for the assignment of a preventive action limit. This limit is used as a tool in identifying

potential threats to groundwater and determining when additional monitoring may be appropriate. According to Chapter 160 Stats., the preventive action limit is to be set at 20% of the enforcement standard. For substances with carcinogenic, mutagenic or teratogenic properties or interactive effects, the preventive action limit is to set at 10% of the enforcement standard. In considering the data presented here, the Department of Health and Family Services finds that ammonia has not been shown to have carcinogenic, mutagenic or teratogenic properties or interactive effects. Therefore, a 20% preventive action limit is appropriate.

one study did show this! Tsuji (1995)

Recommended preventive action limit: 1.9 mg/L as ammonia-nitrogen

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Is this correct? misit ~~sulfa~~ sulfamate

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ADDITIONAL REFERENCES
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administration with MAO inhibitors has been considered an absolute contraindication; however, patients with refractory depression have received combination therapy without significant adverse effects. If used in combination therapy, give the drugs orally, avoid large doses and monitor the patient closely. Not recommended during the acute recovery phase following myocardial infarction, and in the presence of acute congestive heart failure.

Precautions: May block the antihypertensive action of guanethidine or similarly acting compounds.

Should be used with caution in patients with a history of seizures or urinary retention, or with narrow angle glaucoma or increased intraocular pressure.

Arrhythmias, sinus tachycardia, and prolongation of the conduction time have been reported, particularly with high doses. A few instances of unexpected death have been reported in patients with cardiovascular disorders. Myocardial infarction and stroke have also been reported with drugs of this class. Therefore, these drugs should be used with caution in patients with a history of cardiovascular diseases such as myocardial infarction and congestive heart failure.

Close supervision is required for hyperthyroid patients or those receiving thyroid medication.

Occupational hazards: May impair mental and/or physical abilities required for performance of hazardous tasks, such as operating machinery or driving a motor vehicle.

Pregnancy and lactation: Safe use during pregnancy and lactation has not been established. In pregnant patients, nursing mothers, or women who may become pregnant, weigh possible benefits against possible hazards to mother and child. Amitriptyline and nortriptyline are excreted in low concentrations in breast milk.

Schizophrenic patients and those with paranoid symptomatology may have increased symptoms; manic depressives may experience a shift to the manic phase. In these circumstances amitriptyline dosage may be reduced or a phenothiazine antipsychotic agent may be administered concurrently.

When given with anticholinergic agents or sympathomimetic drugs, close supervision and careful adjustment of dosages are required. May enhance the response to alcohol and the effects of barbiturates and other CNS depressants.

The possibility of suicide in depressed patients remains during treatment and until significant remission occurs; this type of patient should not have easy access to large quantities of the drug.

Concurrent electroshock therapy may increase the hazards of therapy; such treatment should be limited to patients for whom it is essential.

Discontinue the drug several days before elective surgery if possible.

Adverse Effects: Note: Included in this listing are a few adverse reactions not reported with this specific drug. However, pharmacological similarities among the tricyclic antidepressant drugs require that each reaction be considered when amitriptyline is administered.

Behavioral: activation of latent schizophrenia; high doses may cause temporary confusion or disturbed concentration, or rarely, transient visual hallucinations; hypomanic reactions; drowsiness which usually disappears with continuance of therapy; insomnia, giddiness, restlessness, agitation, fatigue, nightmares, disorientation, delusions, excitement, anxiety, and jitteriness.

Neurological: epileptiform seizures; numbness, tingling, paresthesias of the limbs, including peripheral neuropathy; dizziness, fine tremor, headache, ataxia, seizures, alteration in EEG patterns, extrapyramidal symptoms, tinnitus and incoordination; severe tremor only observed with high doses.

Autonomic: evidence of anticholinergic activity, such as urinary retention, reversible dilatation of the urinary tract, constipation, and more rarely, paralytic ileus of particular concern in the elderly; dry mouth, blurred vision and disturbance of accommodation.

Cardiovascular: a quinidine like effect and other reversible ECG changes such as flattening or inversion of T waves, and bundle branch block; orthostatic hypotension, hypertension, palpitation, arrhythmias, heart block, and, with toxic doses, ventricular tachycardia and fibrillation; myocardial infarction and stroke. A few instances of unexpected death have been reported in patients with cardiovascular disorders.

Toxic and allergic effects: bone marrow depression including agranulocytosis, eosinophilia, purpura and thrombocytopenia; jaundice rarely. Allergic type reactions manifested by skin rash, urticaria, photosensitization or swelling of the face and tongue and itching occurred rarely.

Gastrointestinal: nausea, epigastric distress, heartburn, vomiting, anorexia, stomatitis, peculiar taste, diarrhea, parotid swelling, black tongue.

Endocrine: testicular swelling and gynecomastia in the male, breast enlargement and galactorrhea in the female, increased or decreased libido, elevation and lowering of blood sugar levels.

Metabolic: increased appetite, weight gain or weight loss in some patients.

Ophthalmologic: precipitation of latent glaucoma or aggravation of existing glaucoma; blurred vision and mydriasis.

Miscellaneous: other side effects that may occur include fainting, weakness, urinary frequency, increased perspiration, and alopecia.

Withdrawal symptoms: abrupt cessation of treatment after prolonged administration may produce nausea, headache, and malaise; these are not indicative of addiction.

Overdose: Symptoms: High doses may cause temporary confusion, disturbed concentration, transient visual hallucinations, agitation, hyperactive reflexes, muscle rigidity, vomiting, or hyperpyrexia, in addition to anything listed under Adverse Effects. Based on amitriptyline's known pharmacologic actions, overdosage may cause drowsiness, hypothermia, tachycardia and other arrhythmic abnormalities such as bundle branch block, ECG evidence of impaired conduction and congestive heart failure. Other manifestations may be dilated pupils, convulsions, severe hypotension, stupor and coma. All patients suspected of having taken an overdose should be admitted to a hospital as soon as possible.

Treatment: Symptomatic and supportive. Empty the stomach as quickly as possible by emesis or gastric lavage. Follow with activated charcoal (50 to 100 g), plus saline cathartic every 4 to 6 hours during the first 24 hours after ingestion as the drug is enterohepatically recycled.

Monitor cardiac function for any signs of dysrhythmia. Asymptomatic patients should be monitored for 6 hours. Patients with ECG changes should be monitored for 24 to 48 hours after ECG has returned to normal.

Maintain ventilation; regulate body temperature.

Maintain fluid and electrolyte balance. Alkalinize blood to pH 7.4 to 7.5 with I.v. sodium bicarbonate. This may prevent tachycardia and other cardiac arrhythmias. Phenytoin may be used for arrhythmias refractory to sodium bicarbonate. Propranolol is effective but its negative inotropic effect may cause hypotension so it should be used with caution. Avoid quinidine and procainamide.

Diazepam i.v. may be given to control seizures.

Forced diuresis, peritoneal dialysis, hemodialysis or charcoal hemoperfusion are not effective in increasing elimination.

Since overdosage is often deliberate, patients may attempt suicide by other means during the recovery phase. Deaths by deliberate or accidental overdosage have occurred with this class of drugs.

Physostigmine has been useful in treatment of convulsions, cardiac arrhythmias and hallucinations. Not recommended for routine use or to reverse coma. Administer I.v. over 2 minutes to avoid seizures. Adult dose: 2 mg; pediatric dose: 0.5 mg. Repeat as required. Have atropine on hand to counteract excessive cholinergic effects.

Dosage: Orally: Dosage should be initiated at a low level and increased gradually, noting carefully the clinical response and any evidence of intolerance.

Initial dose for adults: 25 mg 3 times a day. If necessary, increase doses preferably in the late afternoon and/or bedtime to total of 150 mg a day.

Hospitalized patients may require 100 mg a day initially; increased gradually to 200 mg a day if necessary. A small number need as much as 300 mg a day.

Adolescent and elderly patients: In general, lower dosages recommended: 10 mg 3 times a day with 20 mg at bedtime may be satisfactory.

Maintenance dose is usually 25 mg 2 to 4 times a day. When satisfactory improvement has been reached, reduce to lowest amount that will maintain relief of symptoms.

Children: Not recommended for treatment of depression in children under 12 years of age.

Enuresis: 10 mg at bedtime for children under 6 years of age. In older children increase dosage as necessary, up to 25 mg at bedtime.

Parenterally: 20 to 30 mg i.m. 4 times a day. Change to oral route as soon as possible.

Reviewed 1986

AMMONIUM CHLORIDE

Ammonium Muriate

Diuretic—Urinary Acidifier

Pharmacology: Ammonium chloride is rapidly absorbed from the gastrointestinal tract. The ammonium cation is converted into urea in the liver. Chloride ion causes an increased chloride load on the renal tubules such that sodium and an iso-osmotic quantity of water are excreted with the excess chloride. A mild metabolic acidosis accompanies the mild diuresis. This has been used, in the past, to increase the diuretic effect of mercurial diuretics.

Indications: Ammonium chloride is used as a weak diuretic and in small doses as an ingredient of expectorant cough mixtures.

Ammonium chloride has been used in severe states of metabolic alkalosis.

Ammonium chloride has been used to acidify the urine in patients with amphetamine overdosage in order to hasten the urinary excretion of this drug.

Ammonium chloride has also been used for its diuretic effect in premenstrual edema and Ménière's disease.

Contraindications: Presence of advanced renal or hepatic disease.

Precautions: Use with caution in the management of cardiac edema.

Adverse Effects: Hyperchloremic metabolic acidosis, excessive doses or prolonged use may cause gastric upset, nausea or vomiting thirst, headache, hyperventilation, progressive drowsiness, mental confusion. Rapid I.v. injection may produce irregular breathing bradycardia and twitching.

Overdose: Treatment: For acidosis and electrolyte loss, I.v. sodium bicarbonate or sodium lactate. Correction of hypokalemia may be necessary.

Dosage: The dosage of ammonium chloride as a diuretic or urinary acidifier is 4 to 12 g daily in divided doses every 4 to 6 hours. The average dose is about 8 g. The drug is more effective as a diuretic when given for 3 to 4 days followed by a rest period of a few days after which therapy is again resumed.

As an expectorant, ammonium chloride is given in doses of 500 mg taken with a glassful of water every 2 to 4 hours.

Reviewed 1987

AMOBARBITAL ◇
AMOBARBITAL SODIUM ◇

Amylobarbitone *Sedative—Hypnotic*

Indications: Oral amobarbital and amobarbital sodium preparations are indicated in conditions requiring degrees of sedation ranging from minimal doses for the relief of anxiety and tension to hypnotic doses for sleep and for preanesthetic medication.

Amobarbital sodium may be used i.v. or i.m., for the control of convulsive seizures such as may be due to chorea, eclampsia, meningitis, tetanus, procaine or cocaine reactions, or poisoning from such drugs as strychnine or picrotoxin. It also may be administered for the management of catatonic and negativistic reactions, manic reactions, and epileptiform seizures. It is also useful in narcoanalysis and narcotherapy and as a diagnostic aid in schizophrenia in experienced hands.

Contraindications: Patients with porphyria, severely impaired liver function, sleep apnea, suicidal potential and alcoholism. Do not use in the presence of uncontrolled pain as excitement may be produced. Do not administer to patients who are known to be hypersensitive to barbituric acid derivatives. Should not be administered to elderly patients who exhibit nocturnal confusion or restlessness from sedative hypnotic drugs. Persons who are known to be, or are likely to become, dependent on sedative hypnotic medications.

Precautions: May be habit forming. Use with caution in patients with decreased liver and renal function, since a prolongation of effect may occur.

Occupational hazards: Amobarbital may impair the mental and/or physical abilities required for the performance of potentially hazardous tasks such as driving a vehicle or operating machinery.

The concomitant use of alcohol or other CNS depressants may have an additive effect. Warn patients accordingly.

Drugs interactions: Barbiturates induce liver microsomal enzyme activity and may thus decrease blood concentrations and clinical efficacy of drugs given concurrently. It is necessary to monitor closely the dosage of oral anticoagulants, theophylline and other drugs when initiating or discontinuing barbiturate therapy.

A reduced efficacy and increase in incidence of breakthrough bleeding have been reported in oral contraceptive users treated concomitantly with barbiturates.

Prolonged use of barbiturates, even in therapeutic dosages, may result in psychological dependence. Withdrawal symptoms may occur after chronic use of large doses, resulting in delirium, convulsions, or death.

Pregnancy and lactation: Barbiturates readily cross the placental barrier and drug traces have been found in the breast milk of nursing mothers. Therefore, use of this drug should be avoided during pregnancy and lactation.

Dosage and rate of administration should be selected with great care in patients with hypertension, hypotension, or pulmonary or cardiovascular diseases. Rarely, rickets and osteomalacia have been reported following prolonged usage of barbiturates.

Amobarbital sodium is not recommended as an anesthetic agent, but if a patient develops physical signs of severe depression, he should be treated as though deeply anesthetized. Pulmonary edema may complicate long periods of unconsciousness.

If the condition of the patient justifies the i.v. administration of amobarbital sodium, close hospital supervision is also indicated.

If rapidly induced, deep, or protracted hypnosis is not necessary, the effect of amobarbital sodium should be obtained with oral preparations.

Adverse Effects: Idiosyncrasy, in the form of excitement, hangover, or pain, may appear. Hypersensitivity reactions occur in some patients especially in those with asthma, urticaria, or angioneurotic edema.

Overdose: Symptoms: Respiratory depression, depression of superficial and deep reflexes, constriction of the pupils to a slight degree (though in severe poisoning they may dilate), decreased urine formation, lowered body temperature, and coma.

Treatment: General management should consist in symptomatic and supportive therapy, including gastric lavage, administration of i.v. fluids, and maintenance of blood pressure, body temperature, and adequate respiratory exchange. An artificial kidney will increase the rate of removal of barbiturates from the body fluids.

PB88-179874

EPA/600/6-87/008
February 1988

RECOMMENDATIONS FOR AND DOCUMENTATION OF BIOLOGICAL VALUES FOR USE IN RISK ASSESSMENT

EPA Project Officer:
K. Blackburn

ENVIRONMENTAL CRITERIA AND ASSESSMENT OFFICE
OFFICE OF HEALTH AND ENVIRONMENTAL ASSESSMENT
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OH 45268

TABLE 1-2

Reference Body Weights (kg)

Group	Species/Strain	Sex	Weaning	Subchronic	Chronic	Mature
Primates	monkey, rhesus	M	1.0		10.9	12
		F	1.0		8.0 (0-35 years)	9 (10-35 years)
	chimpanzee	M	3.8		19.25 (0-55 years)	20 (adult)
Laboratory rodents	mice/BAF1	M	0.008	0.0223	0.0261	0.035
		F	0.007	0.0204	0.0222	0.030 (1 year)
	mice/B6C3F1	M	0.009	0.0316	0.0373	0.040
		F	0.011	0.0246	0.0353	0.035 (1 year)
	rats*/ Fischer 344	M	0.031	0.190	0.380	0.40
		F	0.030	0.124	0.229	0.25 (1 year)
	rats/Long-Evans	M	0.040	0.248	0.472	0.50
		F	0.038	0.179	0.344	0.35 (1 year)
	rats/ Osborne-Mendel	M	0.053	0.263	0.518	0.55
		F	0.052	0.201	0.389	0.40 (1 year)


FORWARD
E PLURIBUS UNUM

11-28-05

In WI:
- 115,000 total Cases
- 1-37 of all chemicals being used is Alachlor

Clearinghouse Rule 02-095

Rule Sent to Clearinghouse

ORDER OF THE STATE OF WISCONSIN
NATURAL RESOURCES BOARD
AMENDING RULES

Alachlor is very water soluble.

The Wisconsin Natural Resources Board proposes an order to amend NR 140.10 Table 1 and Appendix 1, relating to groundwater quality standards.

DG-37-02

Analysis Prepared by the Department of Natural Resources

Statutory authority: ss.281.12(1), 281.15, 281.19(1) and 299.11, Stats., and ch. 160, Stats.

Statutes interpreted: ss. 281.12(1), 281.15, 281.19(1) and 299.11, Stats., and ch. 160, Stats.

Chapter 160, Stats., requires the Department to develop numerical groundwater quality standards, consisting of enforcement standards and preventive action limits. Chapter NR 140, Wis. Adm. Code, establishes groundwater standards and creates a framework for implementation of the standards by the Department. The proposed amendments to ch. NR 140 would add groundwater quality standards for 2 additional substances and revise existing groundwater quality standards for 3 substances. In accordance with ch. 160, Stats., amendments to ch. NR 140 groundwater quality standards are based on recommendations from the Department of Health and Family Services. New public health related groundwater quality standards are proposed for Alachlor ethane sulfonic acid (Alachlor ESA) and Molybdenum. Revised public health related groundwater quality standards are proposed for Butylate, Dacthal and Naphthalene.

Herbicide use for Soybeans & Corn.

SECTION 1. NR 140.10, Table1 is amended to read:

Parent Causes Cancer

Mis breaks down from Alachlor (the parent)

1993 Health Advisory

Table 1
Public Health Groundwater Quality Standards

ES

PAL

Substance[1]	Enforcement Standard (micrograms per liter except as noted)	Preventive Action Limit (micrograms per liter except as noted)
Acetone	1000	200
Alachlor (PARENT)	2	0.2
Alachlor ethane sulfonic acid (Alachlor ESA)[2]	20	4
Aldicarb	10	2
Antimony	6	1.2
Anthracene	3000	600
Arsenic	50	5
Asbestos	7 million fibers per liter (MFL)	0.7 MFL
Atrazine, total chlorinated residues	3[3]	0.3[3]
Bacteria, Total Coliform	0[4]	0[4]

NR140 Standard

Monsanto Company was asked to study. They said No. No New data since 1993.

STANDARD ELSEWHERE
MN 40 (WAS 100)
NC .4
EU .1 (European Union)

* 13 wells found contaminated

Barium	2 milligrams/liter (mg/l)	0.4 mg/l
Bentazon	300	60
Benzene	5	0.5
Benzo(b)fluoranthene	0.2	0.02
Benzo(a)pyrene	0.2	0.02
Beryllium	4	0.4
Boron	960	190
Bromodichloromethane	0.6	0.06
Bromoform	4.4	0.44
Bromomethane	10	1
Butylate	~~67~~ 400	~~6.7~~ 80
Cadmium	5	0.5
Carbaryl	960	192
Carbofuran	40	8
Carbon disulfide	1000	200
Carbon tetrachloride	5	0.5
Chloramben	150	30
Chlordane	2	0.2
Chloroethane	400	80
Chloroform	6	0.6
Chloromethane	3	0.3
Chromium	100	10
Chrysene	0.2	0.02
Cobalt	40	8
Copper	1300	130
Cyanazine	1	0.1
Cyanide	200	40
Dacthal	~~4 mg/l~~ 70	~~0.8 mg/l~~ 14
1,2-Dibromoethane (EDB)	0.05	0.005
Dibromochloromethane	60	6
1,2-Dibromo-3-chloropropane (DBCP)	0.2	0.02
Dibutyl phthalate	100	20
Dicamba	300	60
1,2-Dichlorobenzene	600	60
1,3-Dichlorobenzene	1250	125
1,4-Dichlorobenzene	75	15
Dichlorodifluoromethane	1000	200
1,1-Dichloroethane	850	85
1,2-Dichloroethane	5	0.5
1,1-Dichloroethylene	7	0.7
1,2-Dichloroethylene (cis)	70	7
1,2-Dichloroethylene (trans)	100	20
2,4-Dichlorophenoxyacetic Acid (2,4-D)	70	7
1,2-Dichloropropane	5	0.5
1,3-Dichloropropene (cis/trans)	0.2	0.02
Di (2-ethylhexyl) phthalate	6	0.6
Dimethoate	2	0.4
2,4-Dinitrotoluene	0.05	0.005
2,6-Dinitrotoluene	0.05	0.005
Dinoseb	7	1.4
Dioxin (2, 3, 7, 8-TCDD)	0.00003	0.000003
Endrin	2	0.4
EPTC	250	50
Ethylbenzene	700	140
Ethylene glycol	7 mg/l	0.7 mg/l
Fluoranthene	400	80
Fluorene	400	80
Fluoride	4 mg/l	0.8 mg/l
Fluorotrichloromethane	3490	698
Formaldehyde	1000	100
Heptachlor	0.4	0.04
Heptachlor epoxide	0.2	0.02

Hexachlorobenzene	1	0.1
N-Hexane	600	120
Hydrogen sulfide	30	6
Lead	15	1.5
Lindane	0.2	0.02
Mercury	2	0.2
Methanol	5000	1000
Methoxychlor	40	4
Methylene chloride	5	0.5
Methyl ethyl ketone (MEK)	460	90
Methyl isobutyl ketone (MIBK)	500	50
Methyl tert-butyl ether (MTBE)	60	12
Metolachlor	15	1.5
Metribuzin	250	50
Molybdenum	40	8
Monochlorobenzene	100	20
Naphthalene	~~40~~ 100	~~8~~ 10
Nickel	100	20
Nitrate (as N)	10 mg/l	2 mg/l
Nitrate + Nitrite (as N)	10 mg/l	2 mg/l
Nitrite (as N)	1 mg/l	0.2 mg/l
N-Nitrosodiphenylamine	7	0.7
Pentachlorophenol (PCP)	1	0.1
Phenol	6 mg/l	1.2 mg/l
Picloram	500	100
Polychlorinated biphenyls (PCBs)	0.03	0.003
Prometon	90	18
Pyrene	250	50
Pyridine	10	2
Selenium	50	10
Silver	50	10
Simazine	4	0.4
Styrene	100	10
1,1,1,2-Tetrachloroethane	70	7
1,1,2,2-Tetrachloroethane	0.2	0.02
Tetrachloroethylene	5	0.5
Tetrahydrofuran	50	10
Thallium	2	0.4
Toluene	1 mg/l	0.2 mg/l
Toxaphene	3	0.3
1,2,4-Trichlorobenzene	70	14
1,1,1-Trichloroethane	200	40
1,1,2-Trichloroethane	5	0.5
Trichloroethylene (TCE)	5	0.5
2,4,5-Trichlorophenoxy-propionic acid (2,4,5-TP)	50	5
1,2,3-Trichloropropane	60	12
Trifluralin	7.5	0.75
Trimethylbenzenes (1,2,4- and 1,3,5- combined)	480	96
Vanadium	30	6
Vinyl chloride	0.2	0.02
Xylene[5]	10 mg/l	1 mg/l

[1] Appendix I contains Chemical Abstract Service (CAS) registry numbers, common synonyms and trade names for most substances listed in Table 1.

[2]Synonyms for the ethane sulfonic acid metabolite of Alachlor (Alachlor ESA) include: MON 5775; 2',6'-diethyl-N-methoxymethyl-2-sulfoacetanilide, sodium salt and 2-[2,6-diethylphenyl(methoxymethyl) amino]-2-oxoethane sulfonic acid, sodium salt.

[3]Total chlorinated atrazine residues includes parent compound and the following metabolites of health concern: 2-chloro-4-amino-6-isopropylamino-s-triazine (formerly deethylatrazine), 2-chloro-4-amino-6-ethylamino-s-triazine (formerly deisopropylatrazine) and 2-chloro-4,6-diamino-s-triazine (formerly diaminoatrazine).

[4]Total coliform bacteria may not be present in any 100 ml sample using either the membrane filter (MF) technique, the presence-absence (P-A) coliform test, the minimal medium ONPG-MUG (MMO-MUG) test or not present in any 10 ml portion of the 10-tube multiple tube fermentation (MTF) technique.

[5]Xylene includes meta-, ortho-, and para-xylene combined. The preventive action limit has been set at a concentration that is intended to address taste and odor concerns associated with this substance.

SECTION 2. Appendix 1 to Table 1 is amended to read:

APPENDIX TO TABLE 1
PUBLIC HEALTH GROUNDWATER QUALITY STANDARDS

Substance	**CAS RN[1]**	**Common synonyms/*Tradename*[2]**
Acetone	67-64-1	*Propanone*
Alachlor	15972-60-8	*Lasso*
Aldicarb	116-06-3	*Temik*
Anthracene	120-12-7	Para-naphthalene
Asbestos	12001-29-5	
Bentazon	25057-89-0	*Basagran*
Benzene	71-43-2	
Benzo(b)fluoranthene	205-99-2	B(b)F,3,4-Benzofluoranthene
Benzo(a)pyrene	50-32-8	BaP, B(a)P
Boron	7440-42-8	
Bromodichloromethane	75-27-4	Dichlorobromomethane, BDCM
Bromoform	75-25-2	Tribromomethane
Bromomethane	74-83-9	Methyl bromide
Butylate	2008-41-5	S-ethyl di-isobutylthiocarbamate, *Sutan+*
Carbaryl	63-25-2	*Sevin*
Carbofuran	1563-66-2	*Furadan*
Carbon disulfide	75-15-0	Carbon bisulfide
Carbon tetrachloride	56-23-5	Tetrachloromethane, Perchloroethane
Chloramben	133-90-4	
Chlordane	57-74-9	
Chloroethane	75-00-3	Ethyl chloride, Monochloroethane
Chloroform	67-66-3	Trichloromethane
Chloromethane	74-87-3	Methyl chloride
Chrysene	218-01-9	1,2-Benzphenanthrene
Cobalt	7440-48-4	
Cyanazine	21725-46-2	*Bladex* , 2-chloro-4-ethylamino-6-nitriloisopropylamino-s-triazine
Cyanide	57-12-5	
Dacthal	1861-32-1	DPCA, Chlorothal, *Dacthalor*, 1,4-benzenedicarboxylic acid
Dibromochloromethane	124-48-1	Chlorodibromomethane, DBCM
1,2-Dibromo-3-chloropropane	96-12-8	DBCP, Dibromochloropropane
1,2-Dibromoethane	106-93-4	EDB, Ethylene dibromide, Dibromoethane
Dibutyl phthalate	84-74-2	DP, Di-n-butyl phthalate, n-Butyl phthalate
Dicamba	1918-00-9	*Banvel*
1,2-Dichlorobenzene	95-50-1	o-Dichlorobenzene, o-DCB

1,3-Dichlorobenzene	541-73-1	m-Dichlorobenzene, m-DCB
1,4-Dichlorobenzene	106-46-7	p-Dichlorobenzene, p-DCB
Dichlorodifluoromethane	75-71-8	*Freon 12*
1,1,-Dichloroethane	75-34-3	Ethylidine chloride
1,2-Dichloroethane	107-06-2	1,2-DCA, Ethylene dichloride
1,1-Dichloroethylene	75-35-4	1,1-DCE, 1,1-Dichloroethene, Vinylidene chloride
1,2-Dichloroethylene (cis)	156-59-2	cis-Dichloroethylene, 1,2-Dichloroethene (cis)
1,2-Dichloroethylene (trans)	156-60-5	trans-1,2-Dichloroethylene
2,4-Dichlorophenoxyacetic acid	94-75-7	2,4-D
1,2-Dichloropropane	78-87-5	Propylene dichloride
1,3-Dichloropropene (cis/trans)[3]		*Telone*, DCP, Dichloropropylene
Di(2-ethylhexyl) phthalate	117-81-7	DEHP, Bis(2-ethylhexyl) phthalate, 1,2-Benzenedicarboxylic acid, Bis (2-ethylhexyl)ester
Dimethoate	60-51-5	
2,4-Dinitrotoluene	121-14-2	2,4-DNT, 1-methyl-2,4-dinitrobenzene
2,6-Dinitrotoluene	606-20-2	2,6-DNT, 2-methyl-1,3-dinitrobenzene
Dinoseb	88-85-7	2-(1-methylpropyl)-4,6-dinitrophenol
Dioxin	1746-01-6	2,3,7,8-TCDD,2,3,7,8-Tetrachlorodibenzo-p-dioxin
Endrin	72-20-8	
EPTC	759-94-4	*Eptam, Eradicane*
Ethylbenzene	100-41-4	Phenylethane, EB
Ethylene glycol	107-21-1	
Fluoranthene	206-44-0	Benzo(jk)fluorene
Fluorene	86-73-7	2,3-Benzidine, Diphenylenemethane
Fluoride	16984-48-8	
Fluorotrichloromethane	75-69-4	*Freon11*, Trichlorofluoromethane
Formaldehyde	50-00-0	
Heptachlor	76-44-8	*Velsicol*
Heptachlor epoxide	1024-57-3	
Hexachlorobenzene	118-74-1	Perchlorobenzene, *Granox*
N-Hexane	110-54-3	Hexane, Skellysolve B
Hydrogen sulfide	7783-06-4	Dihydrogen sulfide
Lindane	58-89-9	
Mercury	7439-97-6	
Methanol	67-56-1	Methyl alcohol, Wood alcohol
Methoxychlor	72-43-5	
Methylene chloride	75-09-2	Dichloromethane, Methylene dichloride
Methyl ethyl ketone	78-93-3	MEK, 2-Butanone
Methyl isobutyl ketone	108-10-1	MIBK, 4-Methyl-2-pentanone, Isopropylacetone, *Hexone*
Methyl tert-butyl ether	1634-04-4	MTBE, 2-Methoxy-2-methyl-propane, tert-Butyl methyl ether
Metolachlor	51218-45-2	*Dual, Bicep, Milocep*
Metribuzin	21087-64-9	Sencor, Lexone
Molybdenum	7439-98-7	
Monochlorobenzene	108-90-7	Chlorobenzene
Naphthalene	91-20-3	
N-Nitrosodiphenylamine	86-30-6	NDPA
Pentachlorophenol	87-86-5	PCP, Pentachlorohydroxybenzene
Phenol	108-95-2	
Picloram	1918-02-1	*Tordon*, 4-amino-3,5,6-trichloropicolinic acid
Polychlorinated biphenyls[4]		PCBs
Prometon	1610-18-0	*Pramitol, Prometone*
Pyrene	129-00-0	Benzo(def)phenanthrene
Pyridine	110-86-1	Azabenzene
Simazine	122-34-9	*Princep*, 2-chloro-4,6-diethylamino- s-

		triazine
Styrene	100-42-5	Ethenylbenzene, Vinylbenzene
1,1,1,2-Tetrachlorethane	630-20-6	1,1,1,2-TCA
1,1,2,2,-Tetrachloroethane	79-34-5	1,1,2,2-TCA
Tetrachloroethylene	127-18-4	Perchloroethylene, PERC, Tetrachloroethene
Tetrahydrofuran	109-99-9	THF
Toluene	108-88-3	Methylbenzene
Toxaphene	8001-35-2	
1,2,4-Trichlorobenzene	120-82-1	
1,1,1-Trichloroethane	71-55-6	Methyl chloroform
1,1,2-Trichloroethane	79-00-5	1,1,2-TCA, Vinyl trichloride
Trichloroethylene	79-01-6	TCE, Chloroethene
2,4,5-Trichlorophenoxy-propionic acid	93-72-1	2,4,5-TP,*Silvex*
1,2,3-Trichloropropane	96-18-4	1,2,3-TCP, Glycerol trichlorohyrin
Trifluralin	1582-09-8	*Treflan*
1,2,4-Trimethylbenzene	95-63-6	
1,3,5-Trimethylbenzene	108-67-8	
Vanadium	7440-62-2	
Vinyl chloride	75-01-4	VC, Chloroethene
Xylene[5]		

[1]Chemical Abstracts Service (CAS) registry numbers are unique numbers assigned to a chemical substance. The CAS registry numbers were published by the U.S. Environmental Protection Agency in 40 CFR Part 264, Appendix IV.

[2]Common synonyms include those widely used in government regulations, scientific publications, commerce and the general public. A trade name, also known as the proprietary name, is the specific, registered name given by a manufacturer to a product. Trade names are listed in italics. Common synonyms and trade names should be cross-referenced with CAS registry number to ensure the correct substance is identified.

[3]This is a combined chemical substance which includes cis 1,3-Dichloropropene (CAS RN 10061-01-5) and trans 1,3-Dichloropropene (CAS RN 10061-02-6).

[4]Polychlorinated biphenyls (CAS RN 1336-36-3); this category contains congener chemicals (same molecular composition, different molecular structure and formula), including constituents of Aroclor-1016 (CAS RN12674-11-2), Aroclor-1221 (CAS RN 11104-28-2), Aroclor-1232 (CAS RN 11141-16-5), Aroclor-1242 (CAS RN 53469-21-9), Aroclor-1248 (CAS RN 12672-29-6), Aroclor-1254 (CAS RN 11097-69-1), and Aroclor-1260 (CAS RN 11096-82-5).

[5]Xylene (CAS RN 1330-20-7) refers to a mixture of three isomers, meta-xylene (CAS RN 108-38-3), ortho-xylene (CAS RN 95-47-6), and para-xylene (CAS RN 106-42-3).

The foregoing rules were approved and adopted by the State of Wisconsin Natural Resources Board on _____.

The rules shall take effect on the first day of the month following publication in the Wisconsin administrative register as provided in s. 227.22(2)(intro.), Stats.

Dated at Madison, Wisconsin _____

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

By _____
Darrell Bazzell, Secretary

(SEAL)