State of West Virginia
Department of Administration
Purchasing Division

N O T I C E

Due to the size of this bid, it was impractical to scan every page for online viewing. We have made an attempt to scan and publish all pertinent bid information. However, it is important to note that some pages were necessarily omitted.

If you would like to review the bid in its entirety, please contact the buyer. Thank you.

***

CRYOTECH

December 10, 2009, 2009

Mr. Michael Austin
State of West Virginia
Department of Administration
Purchasing Division
Building 15
2019 Washington Street East
Charleston, WV 25305-0130

RE: Request for Quotation Number 6610C010
Calcium Magnesium Acetate and Non-Corrosive Pre-Wetting Agent

Dear Mr. Austin:

Cryotech Deicing Technology is pleased to respond herein to the subject Request for Quotation.

The products bid shall be Cryotech CMA® solid commercial deicer and Cryotech CF7® clear liquid deicer. Product documentation is included. CMA is 96% calcium magnesium acetate and CF7 is 50% potassium acetate with less than 1% corrosion inhibitors (active material). Both products are produced at Cryotech's Fort Madison, Iowa production facility.

Cryotech will supply the same product as supplied in prior seasons per attached product specifications.

Thank you for this opportunity to work with the West Virginia Division of Highways.

Respectfully Submitted,

DocuSign
Roxie
Thu Dec 10 10:06:50 2009

RECEIVED
2009 DEC 14 A 9:09
PURCHASING DIVISION
STATE OF WV

ROXANNA HUFFMAN
Manager, Operations

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com

CRYOTECH

December 10, 2009

CRYOTECH DEICING TECHNOLOGY
Request for Quotation Number 6610C010
Calcium Magnesium Acetate and Non-Corrosive Pre-Wetting Agent

General (Cryotech Deicing Technology)

- Cryotech's core business is deicers. All personnel are dedicated to meeting customer needs.
- Cryotech is ISO9001:2008 and ISO14001:2004 certified. This assures its customers that Cryotech deicers always meet a rigorous, internationally recognized quality standard, and is committed to protecting our environment.
- Cryotech's web site (www.cryotech.com) provides easy access to all company, product, safety, and ISO information.
- Cryotech welcomes customer site visits and audits.
- Cryotech personnel at its Fort Madison, IA plant are available around-the-clock, seven days a week including holidays.
- All Cryotech carriers are required to ensure that drivers have completed appropriate safety-training programs, including spill handling. This is part of Cryotech's ISO 9001:2008 quality certification and vendor monitoring program.
- Cryotech and its partners have 24-hour customer service utilizing answering services, cellular phones and pagers to ensure that someone is always available to respond.

Calcium Magnesium Acetate (Cryotech CMA®) & Potassium Acetate (CF7®)

- Cryotech has CMA storage capacity at its Iowa plant for 2,500 metric tons and will deliver directly to West Virginia's Oak Hill storage site within 3-5 days after receipt of order (ARO).
- CMA has been produced at this Iowa plant since 1986. From 1986 to 1991 it was produced by Chevron Chemical Company, and since 1992 it has been produced by Cryotech Deicing Technology.
- Cryotech has CF7 storage capacity at its Fort Madison, IA plant and could deliver directly to West Virginia's Oak Hill storage site within 3-5 days ARO.

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
6610C010	1

ADDRESS CORRESPONDENCE TO ATTENTION OF:
MICHAEL AUSTIN
304-558-2402

VENDOR
*609112626 800-346-7237
CRYOTECH DEICING TECHNOLOGY
6103 ORTHOWAY

FORT MADISON IA 52627

REC'D DEC - 7 2009

SHIP TO
DIVISION OF HIGHWAYS
DISTRICT NINE

103 1/2 CHURCH STREET
LEWISBURG, WV
24901 304-647-7457

This should be Oak Hill per Michael Austin 12-10-09. (rh)

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
12/01/2009				

BID OPENING DATE: 12/16/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT NO.	ITEM NUMBER	UNIT PRICE	AMOUNT
0001	1	EA		325-12	See page 12 - price page	

CALCIUM MAGNESIUM ACETATE

OPEN END CONTRACT

TO PROVIDE ALL LABOR, MATERIALS AND EQUIPMENT FOR CALCIUM MAGNESIUM ACETATE AND A NON-CORROSIVE PRE-WETTING AGENT FOR THE WEST VIRGINIA DIVISION OF HIGHWAYS DISTRICT NINE (9) PER THE ATTACHED SPECIFICATIONS.

PURCHASING CARD ACCEPTANCE: THE STATE OF WEST VIRGINIA CURRENTLY UTILIZES A VISA PURCHASING CARD PROGRAM WHIC IS ISSUED THROUGH A BANK. THE SUCCESSFUL VENDOR MUST ACCEPT THE STATE OF WEST VIRGINIA VISA PURCHASING CARD FOR PAYMENT OF ALL ORDERS PLACED BY ANY STATE AGENCY AS A CONDITION OF AWARD.

EXHIBIT 3

LIFE OF CONTRACT: THIS CONTRACT BECOMES EFFECTIVE ON ..... AND EXTENDS FOR A PERIOD OF ONE (1) YEAR OR UNTIL SUCH "REASONABLE TIME" THEREAFTER AS IS NECESSARY TO OBTAIN A NEW CONTRACT OR RENEW THE ORIGINAL CONTRACT. THE "REASONABLE TIME" PERIOD SHALL NOT EXCEED TWELVE (12) MONTHS. DURING THIS "REASONABLE TIME" THE VENDOR MAY TERMINATE THIS CONTRACT FOR ANY REASON UPON GIVING THE DIRECTOR OF PURCHASING 30 DAYS WRITTEN NOTICE.

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Roxanne Hupp TELEPHONE 800-346-7237 DATE 12-11-09

TITLE Manager, Operations FEIN 33-0270225 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

GENERAL TERMS & CONDITIONS
REQUEST FOR QUOTATION (RFQ) AND REQUEST FOR PROPOSAL (RFP)

1. Awards will be made in the best interest of the State of West Virginia.

2. The State may accept or reject in part, or in whole, any bid.

3. All quotations are governed by the ***West Virginia Code*** and the ***Legislative Rules*** of the Purchasing Division.

4. Prior to any award, the apparent successful vendor must be properly registered with the Purchasing Division and have paid the required $125 fee.

5. All services performed or goods delivered under State Purchase Order/Contracts are to be continued for the term of the Purchase Order/Contracts, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise available for these services or goods, this Purchase Order/Contract becomes void and of no effect after June 30.

6. Payment may only be made after the delivery and acceptance of goods or services.

7. Interest may be paid for late payment in accordance with the ***West Virginia Code.***

8. Vendor preference will be granted upon written request in accordance with the ***West Virginia Code.***

9. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

10. The Director of Purchasing may cancel any Purchase Order/Contract upon 30 days written notice to the seller.

11. The laws of the State of West Virginia and the ***Legislative Rules*** of the Purchasing Division shall govern all rights and duties under the Contract, including without limitation the validity of this Purchase Order/Contract.

12. Any reference to automatic renewal is hereby deleted. The Contract may be renewed only upon mutual written agreement of the parties.

13. BANKRUPTCY: In the event the vendor/contractor files for bankruptcy protection, the State may deem this contract null and void, and terminate such contract without further order.

14. HIPAA BUSINESS ASSOCIATE ADDENDUM: The West Virginia State Government HIPAA Business Associate Addendum (BAA), approved by the Attorney General, and available online at the Purchasing Division's web site **(http://www.state.wv.us/admin/purchase/vrc/hipaa.htm)** is hereby made part of the agreement. Provided that, the Agency meets the definition of a Cover Entity (45 CFR §160.103) and will be disclosing Protected Health Information (45 CFR §160.103) to the vendor.

15. WEST VIRGINIA ALCOHOL & DRUG-FREE WORKPLACE ACT: If this Contract constitutes a public improvement construction contract as set forth in Article 1D, Chapter 21 of the West Virginia Code ("The West Virginia Alcohol and Drug-Free Workplace Act"), then the following language shall hereby become part of this Contract: "The contractor and its subcontractors shall implement and maintain a written drug-free workplace policy in compliance with the West Virginia Alcohol and Drug-Free Workplace Act, as set forth in Article 1D, Chapter 21 of the West Virginia Code. The contractor and its subcontractors shall provide a sworn statement in writing, under the penalties of perjury, that they maintain a valid drug-free work place policy in compliance with the West Virginia and Drug-Free Workplace Act. It is understood and agreed that this Contract shall be cancelled by the awarding authority if the Contractor: 1) Fails to implement its drug-free workplace policy; 2) Fails to provide information regarding implementation of the contractor's drug-free workplace policy at the request of the public authority; or 3) Provides to the public authority false information regarding the contractor's drug-free workplace policy."

INSTRUCTIONS TO BIDDERS

1. Use the quotation forms provided by the Purchasing Division.

2. SPECIFICATIONS: Items offered must be in compliance with the specifications. Any deviation from the specifications must be clearly indicated by the bidder. Alternates offered by the bidder as **EQUAL** to the specifications must be clearly defined. A bidder offering an alternate should attach complete specifications and literature to the bid. The Purchasing Division may waive minor deviations to specifications.

3. Complete all sections of the quotation form.

4. Unit prices shall prevail in case of discrepancy.

5. All quotations are considered F.O.B. destination unless alternate shipping terms are clearly identified in the quotation.

6. BID SUBMISSION: All quotations must be delivered by the bidder to the office listed below prior to the date and time of the bid opening. Failure of the bidder to deliver the quotations on time will result in bid disqualifications: Department of Administration, Purchasing Division, 2019 Washington Street East, P.O. Box 50130, Charleston, WV 25305-0130

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
6610C010	2

ADDRESS CORRESPONDENCE TO ATTENTION OF:
MICHAEL AUSTIN
304-558-2402

VENDOR
*609112626 800-346-7237
CRYOTECH DEICING TECHNOLOGY
6103 ORTHOWAY

FORT MADISON IA 52627

SHIP TO
DIVISION OF HIGHWAYS
DISTRICT NINE

103 1/2 CHURCH STREET
LEWISBURG, WV
24901 304-647-7457

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
12/01/2009				

BID OPENING DATE: 12/16/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT

UNLESS SPECIFIC PROVISIONS ARE STIPULATED ELSEWHERE IN THIS CONTRACT DOCUMENT, THE TERMS, CONDITIONS AND PRICING SET HEREIN ARE FIRM FOR THE LIFE OF THE CONTRACT.

RENEWAL: THIS CONTRACT MAY BE RENEWED UPON THE MUTUAL WRITTEN CONSENT OF THE SPENDING UNIT AND VENDOR, SUBMITTED TO THE DIRECTOR OF PURCHASING THIRTY (30) DAYS PRIOR TO THE EXPIRATION DATE. SUCH RENEWAL SHALL BE IN ACCORDANCE WITH THE TERMS AND CONDITIONS OF THE ORIGINAL CONTRACT AND SHALL BE LIMITED TO TWO (2) ONE (1) YEAR PERIODS.

CANCELLATION: THE DIRECTOR OF PURCHASING RESERVES THE RIGHT TO CANCEL THIS CONTRACT IMMEDIATELY UPON WRITTEN NOTICE TO THE VENDOR IF THE COMMODITIES AND/OR SERVICES SUPPLIED ARE OF AN INFERIOR QUALITY OR DO NOT CONFORM TO THE SPECIFICATIONS OF THE BID AND CONTRACT HEREIN.

OPEN MARKET CLAUSE: THE DIRECTOR OF PURCHASING MAY AUTHORIZE A SPENDING UNIT TO PURCHASE ON THE OPEN MARKET, WITHOUT THE FILING OF A REQUISITION OR COST ESTIMATE, ITEMS SPECIFIED ON THIS CONTRACT FOR IMMEDIATE DELIVERY IN EMERGENCIES DUE TO UNFORESEEN CAUSES (INCLUDING BUT NOT LIMITED TO DELAYS IN TRANSPORTATION OR AN UNANTICIPATED INCREASE IN THE VOLUME OF WORK.)

QUANTITIES: QUANTITIES LISTED IN THE REQUISITION ARE APPROXIMATIONS ONLY, BASED ON ESTIMATES SUPPLIED BY THE STATE SPENDING UNIT. IT IS UNDERSTOOD AND AGREED THAT THE CONTRACT SHALL COVER THE QUANTITIES ACTUALLY ORDERED FOR DELIVERY DURING THE TERM OF THE CONTRACT, WHETHER MORE OR LESS THAN THE QUANTITIES SHOWN.

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Lorraine J. Shuffman TELEPHONE 800-346-7237 DATE 12-11-09

TITLE Manager, Operations FEIN 33-0270225 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
6610C010	3

ADDRESS CORRESPONDENCE TO ATTENTION OF:
MICHAEL AUSTIN
304-558-2402

VENDOR
*609112626 800-346-7237
CRYOTECH DEICING TECHNOLOGY
6103 ORTHOWAY

FORT MADISON IA 52627

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DIVISION OF HIGHWAYS
DISTRICT NINE

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24901 304-647-7457

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12/01/2009				

BID OPENING DATE: 12/16/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO	ITEM NUMBER	UNIT PRICE	AMOUNT

ORDERING PROCEDURE: SPENDING UNIT(S) SHALL ISSUE A WRITTEN STATE CONTRACT ORDER (FORM NUMBER WV-39) TO THE VENDOR FOR COMMODITIES COVERED BY THIS CONTRACT. THE ORIGINAL COPY OF THE WV-39 SHALL BE MAILED TO THE VENDOR AS AUTHORIZATION FOR SHIPMENT, A SECOND COPY MAILED TO THE PURCHASING DIVISION, AND A THIRD COPY RETAINED BY THE SPENDING UNIT.

BANKRUPTCY: IN THE EVENT THE VENDOR/CONTRACTOR FILES FOR BANKRUPTCY PROTECTION, THE STATE MAY DEEM THE CONTRACT NULL AND VOID, AND TERMINATE SUCH CONTRACT WITHOUT FURTHER ORDER.

THE TERMS AND CONDITIONS CONTAINED IN THIS CONTRACT SHALL SUPERSEDE ANY AND ALL SUBSEQUENT TERMS AND CONDITIONS WHICH MAY APPEAR ON ANY ATTACHED PRINTED DOCUMENTS SUCH AS PRICE LISTS, ORDER FORMS, SALES AGREEMENTS OR MAINTENANCE AGREEMENTS, INCLUDING ANY ELECTRONIC MEDIUM SUCH AS CD-ROM.

REV. 05/26/2009

EXHIBIT 10

REQUISITION NO.: .....

ADDENDUM ACKNOWLEDGEMENT

I HEREBY ACKNOWLEDGE RECEIPT OF THE FOLLOWING CHECKED ADDENDUM(S) AND HAVE MADE THE NECESSARY REVISIONS TO MY PROPOSAL, PLANS AND/OR SPECIFICATION, ETC.

ADDENDUM NO.'S:

NO. 1 .....

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Lorraine J. Heppner TELEPHONE 800-346-7237 DATE 12-11-09

TITLE Manager, Operations FEIN 33-0270225 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
6610C010	4

ADDRESS CORRESPONDENCE TO ATTENTION OF:
MICHAEL AUSTIN
304-558-2402

VENDOR
*609112626 800-346-7237
CRYOTECH DEICING TECHNOLOGY
6103 ORTHOWAY

FORT MADISON IA 52627

SHIP TO
DIVISION OF HIGHWAYS
DISTRICT NINE

103 1/2 CHURCH STREET
LEWISBURG, WV
24901 304-647-7457

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
12/01/2009				

BID OPENING DATE: 12/16/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT

NO. 2 .....

NO. 3 .....

NO. 4 .....

NO. 5 .....

I UNDERSTAND THAT FAILURE TO CONFIRM THE RECEIPT OF THE ADDENDUM(S) MAY BE CAUSE FOR REJECTION OF BIDS.

VENDOR MUST CLEARLY UNDERSTAND THAT ANY VERBAL REPRESENTATION MADE OR ASSUMED TO BE MADE DURING ANY ORAL DISCUSSION HELD BETWEEN VENDOR'S REPRESENTATIVES AND ANY STATE PERSONNEL IS NOT BINDING. ONLY THE INFORMATION ISSUED IN WRITING AND ADDED TO THE SPECIFICATIONS BY AN OFFICIAL ADDENDUM IS BINDING.

Roxanne Huffman
.....
SIGNATURE

Cryotech Deicing Technology, a division of General Atomics International Services Corporation
COMPANY

12-11-09
.....
DATE

NOTE: THIS ADDENDUM ACKNOWLEDGEMENT SHOULD BE SUBMITTED WITH THE BID.

REV. 09/21/2009

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE	TELEPHONE	DATE
Roxanne Huffman	800-346-7237	12-11-09

TITLE	FEIN	ADDRESS CHANGES TO BE NOTED ABOVE
Manager, Operations	33-0270225	

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
6610C010	5

ADDRESS CORRESPONDENCE TO ATTENTION OF:
MICHAEL AUSTIN
304-558-2402

VENDOR
*609112626 800-346-7237
CRYOTECH DEICING TECHNOLOGY
6103 ORTHOWAY

FORT MADISON IA 52627

SHIP TO
DIVISION OF HIGHWAYS
DISTRICT NINE

103 1/2 CHURCH STREET
LEWISBURG, WV
24901 304-647-7457

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
12/01/2009				

BID OPENING DATE: 12/16/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT

NOTICE

A SIGNED BID MUST BE SUBMITTED TO:

DEPARTMENT OF ADMINISTRATION
PURCHASING DIVISION
BUILDING 15
2019 WASHINGTON STREET, EAST
CHARLESTON, WV 25305-0130

THE BID SHOULD CONTAIN THIS INFORMATION ON THE FACE OF THE ENVELOPE OR THE BID MAY NOT BE CONSIDERED:

SEALED BID

BUYER: 33

RFQ. NO.: 6610C010

BID OPENING DATE: 12-16-09

BID OPENING TIME: 1:30 pm

PLEASE PROVIDE A FAX NUMBER IN CASE IT IS NECESSARY TO CONTACT YOU REGARDING YOUR BID:
319-372-2662

CONTACT PERSON (PLEASE PRINT CLEARLY):
Roxanna Huffman

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Roxanna Huffman TELEPHONE 800-346-7237 DATE 12-11-09

TITLE Manager, Operations FEIN 33-0270225 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
6610C010	6

ADDRESS CORRESPONDENCE TO ATTENTION OF:
MICHAEL AUSTIN
304-558-2402

VENDOR
*609112626 800-346-7237
CRYOTECH DEICING TECHNOLOGY
6103 ORTHOWAY

FORT MADISON IA 52627

SHIP TO
DIVISION OF HIGHWAYS
DISTRICT NINE

103 1/2 CHURCH STREET
LEWISBURG, WV
24901 304-647-7457

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
12/01/2009				

BID OPENING DATE: 12/16/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT
	****** THIS IS THE END OF RFQ 6610C010 ****** TOTAL:					$182,518.25

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Rozanna Huffman TELEPHONE 800-346-7237 DATE 12-11-09

TITLE Manager, Operations FEIN 33-0270225 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

1. SPECIFICATIONS

The following sections of the West Virginia Department of Transportation, Division of Highways Standard Specifications Roads and Bridges, adopted 2000, as modified by the current Supplemental Specifications shall apply to the Administration of this Contract: Sections 101, 102.4, 102.5, 105.1, 105.3, 105.4, 105.10, 105.11, 105.12, 105.13, 106.3, 106.4, 106.5, 106.6, 106.7, 106.9, 107.1, 107.2, 107.3, 107.14, 107.19, 107.20, 108.8, 109.1, 109.2 and 109.20.

The requirements of the West Virginia Department of Transportation, Division of Highways, Standard Specifications Section 109.20, PRICE ADJUSTMENT FOR LOAD LIMIT VIOLATIONS, shall apply to all material supplied under this contract. This will include material loaded by the vendor into Division of Highways owner and/or rented trucks.

The terms "Contractor" and "Vendor" used in the above specifications of this contract are interchangeable. Contractor shall mean Vendor and Vendor shall mean Contractor.

West Virginia Department of Transportation, Division of Highways' Standard Specifications Roads and Bridges, adopted 2000 and may be obtained from:

West Virginia Division of Highways
Engineering Division, Technical Section
1900 Kanawha Blvd., East, Bldg. 5, Rm A650
Charleston, West Virginia 25305

2. Calcium Magnesium Acetate shall conform to the following product specifications and shall be delivered in bulk.

PRODUCT SPECIFICATION

Composition: A nominal 3/7 Calcium Magnesium Acetate (CMA) of this analysis:

$Ca_xMg_y\ (C_2H_3O_2)\ 2(x+y)$

x = 3 to 4
y = 7 to 6

CMA	~~91%~~ Min.	See attached
Water (Free & Hydration)	5% Max.	specification
Water-Insoluble Material	4% Max.	

Particle Size:

Sieve	% Passing
4	90 Min.
14	10 Max.

Particle Shape:	Hard, Angular, ~~Asymmetrical Granules~~ Spherical per enclosed specification
Specific Gravity:	Minimum 1.2
Bulk Density:	40 lb/ft^3 to 44 lb/ft^3
Residual Base:	Maximum 0.4 meg base/gm sample
Product pH:	pH 8 to 10 in a 10% solution

2a. Low corrosive Pre-wetting agent/ no clorides

Density:	At 68 degrees F. 10.7 lbs/gallon
Viscosity:	At 68 degrees F. 10 cp maximum At 32 degrees F. 20 cp maximum
Freezing Point:	-76 degrees F.
Typical ph:	11.0+/- 0.5
Specific Gravity:	At 68 degrees F. 1.25 - 1.30
Container Size:	265 gallon tote

3. BIDDING INSTRUCTIONS

The purpose of this contract is to provide for the delivery of Calcium Magnesium Acetate and a liquid pre-wetting agent to the location listed in the bidding schedule. Actual quantity to be delivered to the location will be specified in a State Contract Purchase Order (SCO), which will be issued by the Division of Highways at the time delivery is required. Any qualification of bids or any modification of the specifications or conditions governing the bids may be cause for their rejection.

4. CONTRACT AWARD

All qualified Vendors who submit a valid bid for "FOB Vendor's Storage Site" will be awarded a contract for this item (see Subsection 9.1).

All qualified Vendors who submit a valid bid for "FOB Division's Storage Site" will be awarded a contract for each location for which their bid is low (see Subsection 9.2).
In the event a Vendor fails to conform to the requirements set out in this contract document, the State Contract Purchase Order or the governing specifications, the Purchase Order Contract may be canceled and re-awarded to the next low bidder.

5. DELIVERY

A State Contract Purchase Order (SCO) for delivery to individual Division of Highways Storage Sites will be issued to the Vendor awarded a contract for that specific location (see Subsection 9.2).

In the event the Vendor to which the SCO is issued is unable to comply with the specified delivery schedule the Division may, at its option, cancel all or part of the SCO and obtain the required quantity of Calcium Magnesium Acetate from the most economical available source.

6. SAMPLING AND TESTING

Upon award of contract, the Vendor shall provide the Division with the proposed source of supply. Acceptance shall be based on suppliers' certification of quality and gradation. This information shall be directed to:

West Virginia Division of Highways
Materials Section
190 Dry Branch Road
Charleston, West Virginia 25306

The Division may conduct sampling and testing to verify material quality or gradation.

7. WEIGHING MATERIALS DELIVERED BY TRUCK

The material shall be weighed on any scales meeting the following requirements. The Vendor is not authorized to ship, nor is the Division authorized to receive, materials prior to the issuance of an "SCO".

All truck scales shall be mounted on solid foundations, which will ensure their remaining plumb and level. All truck scales shall be inspected and sealed by the West Virginia Department of Labor, Bureau of Weights and Measures, or other appropriate agencies of the State or its political subdivision. The Division may, at its option, accept inspection and sealing by out-of-state agencies when the scales are located outside West Virginia.

The Division prefers materials be weighed on digital scales for better accuracy and dependability and thus the increased confidence in record keeping. Therefore, the Division supports and encourages the installation of digital recorders on all truck scales.

These digital recorders shall produce a printed record of the gross, tare and net weights, and the time, date, truck identification and "SCO" numbers. Provisions shall be made for constant zero compensation and further provision shall be

made so that the scales may not be manually manipulated during the printing process. The system shall be interlocked so as to allow printing only when the scale has come to rest. In case of a breakdown of the automatic equipment, the Division of Highways will permit manual operation for forty-eight (48) hours, while equipment is being repaired, before the stated deductions for failure to have digital scales are assessed.

Each truck shall be weighed empty prior to each load.

8. SUPPLYING OTHER ORGANIZATIONAL ENTITIES

In accordance with Chapter 5A, Article 3, Section 9 of the Code of West Virginia the commodities or services contracted for herein shall be available to all local governmental bodies in accordance with the same prices, terms and conditions afforded to the State of West Virginia.

In the event any Vendor does not wish to extend the above prices, terms and conditions of his/her bid and subsequent contract to all political sub-divisions of the State, he must so indicate in a clear and unambiguous manner in his bid.

This indication does not prejudice the award of the contract. If a Vendor does not indicate his refusal to extend the prices, terms and conditions of his bid to other entities of the State he is bound to extend them upon issuance of a purchase order by these entities.

Other organizational entities using this provision of the contract shall do so without any involvement of the Division of Highways. That is, the entity shall make its own purchase arrangements with the Vendor and shall make its own arrangements for payment.

9. VENDOR'S INVOICES

Vendor's invoices must be submitted in original and one copy and contain the following:

a) Division of Highways State Contract Purchase Order (SCO) Number, and this Contract Number.

b) Total quantity and unit price with the total cost of material furnished.

Note: Under no circumstance will the West Virginia Division of Highways accept, or pay for, quantities of materials in excess of the quantity stated on the State Contract Purchase Order.

10. BIDDING FOB VENDOR'S STORAGE SITE

10.1 Bidding F.O.B. Vendor's Storage Site

Location of Storage Site	Bid Price ($/Ton) FOB Vendor's Storage Site (Note 1)
Fort Madison, IA	$1648.80/U.S. ton

Haul By Vendor

@ $110.00 For First Ton-Mile

@ $110.00 For Each Additional Ton-Mile

NOTE 1: Bid price shall include cost of vendor loading Division trucks.

BID SCHEDULE (Continued)

10.2 Bidding F.O.B. Division's Storage Site

CALCIUM MAGNESIUM ACETATE

(DOH CLASSIFICATION 011-010-000004)

DISTRICT 9

PLEASE QUOTE ENGLISH MEASURE ONLY

COUNTY	DELIVERY SITE	ESTIMATED NEEDS (TONS)	BID PRICE (PER TON)
Fayette	Oak Hill	100	$1758.80 per US ton

10.3 Bidding F.O.B. Division Storage Site

LIQUID PRE-WETTING AGENT NON-CLORIDES
(DOH CLASSIFICATION 011-010-000020)

COUNTY	DELIVERY SITE	ESTIMATED NEEDS GALLONS	PER GALLON
Fayette	Oak Hill	~~800~~ 795 gallons	$9.14 per gallon provided in 265 gallon totes

Note 1: Price per gallon shall include delivery cost.

RFQ No. 66100010

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

VENDOR OWING A DEBT TO THE STATE:
West Virginia Code §5A-3-10a provides that: No contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and the debt owed is an amount greater than one thousand dollars in the aggregate.

PUBLIC IMPROVEMENT CONTRACTS & DRUG-FREE WORKPLACE ACT:
If this is a solicitation for a public improvement construction contract, the vendor, by its signature below, affirms that it has a written plan for a drug-free workplace policy in compliance with Article 1D, Chapter 21 of the ***West Virginia Code***. The vendor **must** make said affirmation with its bid submission. Further, public improvement construction contract may not be awarded to a vendor who does not have a written plan for a drug-free workplace policy in compliance with Article 1D, Chapter 21 of the ***West Virginia Code*** and who has not submitted that plan to the appropriate contracting authority in timely fashion. For a vendor who is a subcontractor, compliance with Section 5, Article 1D, Chapter 21 of the ***West Virginia Code*** may take place before their work on the public improvement is begun.

ANTITRUST:
In submitting a bid to any agency for the state of West Virginia, the bidder offers and agrees that if the bid is accepted the bidder will convey, sell, assign or transfer to the state of West Virginia all rights, title and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the state of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the state of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to the bidder.

I certify that this bid is made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership or person or entity submitting a bid for the same materials, supplies, equipment or services and is in all respects fair and without collusion or fraud. I further certify that I am authorized to sign the certification on behalf of the bidder or this bid.

LICENSING:
Vendors must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agencies or political subdivision. Furthermore, the vendor must provide all necessary releases to obtain information to enable the Director or spending unit to verify that the vendor is licensed and in good standing with the above entities.

CONFIDENTIALITY:
The vendor agrees that he or she will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the agency's policies, procedures and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in http://www.state.wv.us/admin/purchase/privacy/noticeConfidentiality.pdf.

Under penalty of law for false swearing (***West Virginia Code*** §61-5-3), it is hereby certified that the vendor affirms and acknowledges the information in this affidavit and is in compliance with the requirements as stated.

Vendor's Name: Cryotech

Authorized Signature: Roxanna Huffman Date: 12-11-09

CRYOTECH

Cryotech Deicing Technology is a division of General Atomics International Services Corporation, a San Diego-based company specializing in energy-related research and product development. In 1992, General Atomics purchased the deicing business of Chevron Chemical Company. Included in the acquisition was the production facility at Fort Madison, Iowa, plus all patents, processes, and rights developed by Chevron. The business was renamed Cryotech Deicing Technology, the root word "Cryo" meaning cold.

A world leader in acetate technology, Cryotech manufactures and markets environmentally compatible acetate-based highway, commercial, and airport runway deicers. Acetates are considered safe for the environment because they readily biodegrade and exhibit low toxicity to vegetation and aquatic life. Acetates have low corrosion rates, and are ideal for application on reinforced concrete structures such as bridges and parking garages. Acetates also have a residual effect, working longer than common deicers.

In 1998, Cryotech's Fort Madison, Iowa plant received ISO 9002 certification for its quality process systems. ISO is an internationally recognized quality model. It provides assurance to customers that the products they receive are produced and shipped under rigorous international quality standards. In March 2002, Cryotech's Ft. Madison, Iowa, plant achieved conversion to ISO 9001:2000 certification. Again in June 2009, Cryotech acheived conversion to ISO 9001:2008. Cryotech also became ISO 14001:2004 certified in 2005. To achieve ISO 14001:2004 certification, a company must establish and maintain a detailed environmental management system which allows it to identify and take required actions that reduce environmental and health risks, while consistently improving its environmental performance. Cryotech is the first manufacturer in its industry to receive certification to both ISO standards, reaffirming its position as industry leader in acetate-based deicers.

In 1999 Cryotech formed an agreement with Kilfrost Ltd. in Europe to manufacture and distribute Kilfrost Type I and Type IV Aircraft deicers throughout North America. The fluids are propylene glycol-based, offering superior environmental and holdover performance.

BSI ISO 14001 EMS 89384

BSI ISO 14001 EMS 89384

PRODUCTS

Cryotech NAAC®

- NAAC is 97% solid anhydrous sodium acetate
- For commercial and airport use - certified to current FAA-approved specifications
- Exothermic: gives off heat, melting ice faster than common deicers
- Requires less material than common deicers
- Is effective to low temperatures: 5°F (-15°C)
- Safer for the environment: low BOD, low toxicity

Cryotech CMA®

- CMA is solid calcium magnesium acetate
- For commercial use as a solid
- May be dissolved and applied as anti-icing liquid
- The safest deicer for concrete, even concrete cured less than one year
- Breaks/inhibits bond between snow/ice and pavement, improving traction
- Works best above 20°F (-7°C)

Cryotech CMA40®

- CMA40 is 40% calcium magnesium acetate and 60% sodium chloride
- For commercial use
- The blend retains many of the benefits of CMA, inhibiting the chloride
- Apply early in the storm to prevent snow/ice bonding
- Works best above 20°F (-7°C)

Cryotech CF7®

- CF7 is liquid potassium acetate
- For commercial use
- Liquid formulation works on contact
- Is not slippery and does not track like common deicers
- Low freezing point of -76°F (-60°C)

Cryotech E36®

- E36 is liquid potassium acetate
- For airport use - certified to current FAA approved specifications
- Excellent anti-icing characteristics
- Less slippery than glycol-based products
- Active at low temperatures
- Safer for the environment: low BOD, low toxicity

Kilfrost ABC-S Plus®

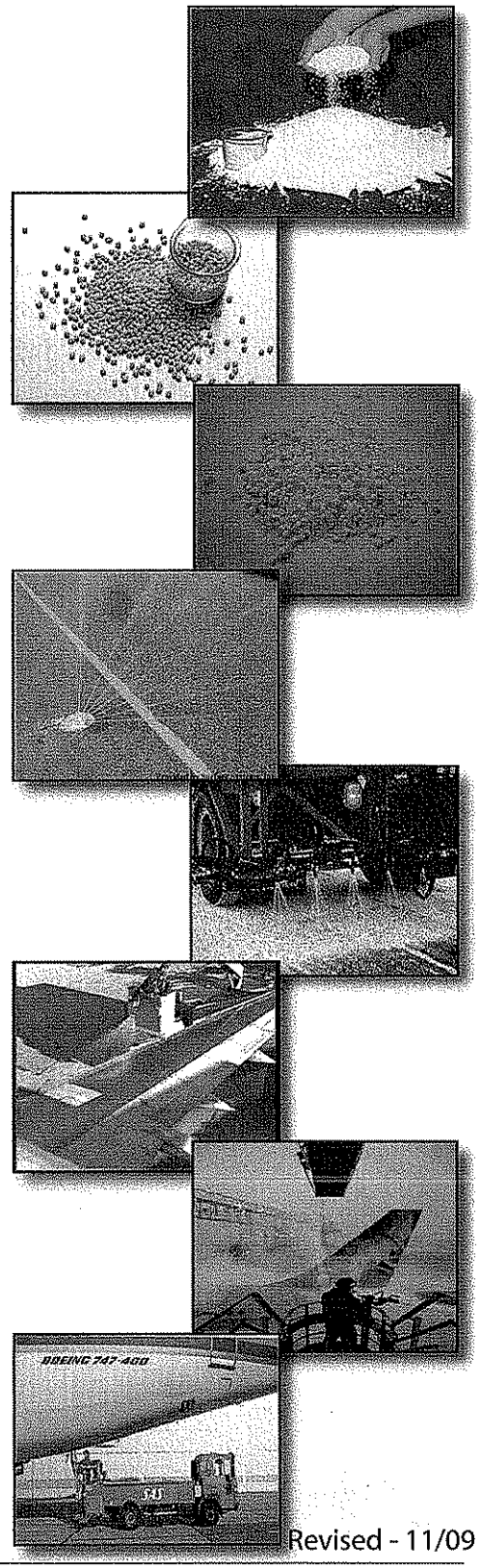
- Type IV propylene glycol fluid
- For aircraft use - certified to current FAA approved specifications
- Long holdover performance in all snow conditions
- Superior sprayability - lack of foam during application
- Long-term fluid stability

Kilfrost DF Plus®

- Type I propylene glycol fluid
- For aircraft use - certified to current FAA approved specifications
- Supplied as concentrate
- Dilute to required temperature for economical savings
- Fully certified triazole-free fluid

Cryotech E36 Lavatory Antifreeze

- Cryotech E36 Lavatory Antifreeze is liquid potassium acetate
- Has low freeze point of -76°F (-60°C)
- May be diluted to desired freeze point
- BOD less than one-third that of propylene gylcol



Revised - 11/09

TO ORDER OR FOR PRODUCT INFORMATION CONTACT:
Ph: +1 319.372.6012 or +1 800.346.7237 Fax: +1 319.372.2662 E-mail: deicers@cryotech.com

CRYOTECH

Working with Cryotech

In its 20 years in the deicer business, Cryotech has been responsible for developing, introducing, and upgrading industry technology, including the introduction to the North American market of calcium magnesium acetate, potassium acetate and sodium acetate. Cryotech has taken leadership roles in the industry, serving on the Society of Automotive Engineers G12 working groups, the Airport Cooperative Research Program, and the Innovative Pavement Research Foundation. Cryotech was the first company to introduce a next generation bio-based liquid runway deicer to address emerging industry concerns and the only company to develop alternative liquid runway deicers to fulfill customer needs during the 2008-2009 potassium acetate shortage. This history has made Cryotech the industry leader in product development and customer service. With a wide range of products, from commercial to aviation and industrial markets, Cryotech is the benchmark by which others are measured.

- **Dedicated Customer Service and Sales Staff**
  At Cryotech, a 24-hour customer service is a must because your needs do not always happen between 9 a.m. and 5 p.m. With a professional sales team and dependable customer service staff on duty every day of the year, Cryotech makes sure you have the deicer and information necessary to do your job successfully.

- **Technical Assistance**
  Cryotech's technical team will answer your questions regarding material and equipment compatibility, product chemistry, product testing or any other questions that your staff may have.

- **Tank and Storage Solutions**
  Cryotech knows your needs go beyond just deicing chemicals, so the staff will provide assistance with tank storage solutions to ensure you have enough inventory when winter weather approaches.

- **On-site Training**
  Cryotech wants you to be successful in applying its deicers, so you can quickly and efficiently get through your winter storm events. Complimentary training, videos and literature are provided to meet your training needs. Please contact Cryotech for more details.

- **An ISO 9001:2008 and 14001:2004 Certified Company**
  ISO standards assure customers that all Cryotech activities - design, manufacturing, production, purchasing, quality control, packaging, handling, storage, shipping, and customer service – are appropriately managed and controlled. This means customers receive products that meet rigorous international quality standards and that Cryotech minimizes its operational impact on the environment.

- **Production Sites and Terminals Across North America**
  Cryotech has over 25 terminals, 150 railcars, and 5 production sites across the United States and Canada. Its distribution system is the industry leader. This ensures Cryotech customers receive the products they need, when they need them.

You can depend on Cryotech when technology, quality, customer service, and distribution systems matter most.

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com

CRYOTECH

September 18, 2009

CRYOTECH DEICING TECHNOLOGY
Research and Development
Invitation to bid: No. _____

Cryotech Deicing Technology is a division of General Atomics International Services Corporation; a San Diego based company specializing in energy-related research and product development. A world leader in acetate technology, Cryotech manufactures and markets environmentally compatible acetate-based highway, commercial and airport runway deicers and is a major supplier to the glycol-based aircraft deicing market.

Cryotech is certified to ISO 9001:2008 and 14001:2004 standards and has established and maintained an Environmental/Quality Management System which includes the Stage Gate process. Stage Gate is a process that allows product development opportunities to be evaluated effectively and efficiently as they arise. The team uses review, verification and validation that are appropriate to each design and development stage to determine project value to customers.

Cryotech personnel, including the President, are active in many working groups that investigate ongoing industry issues. These groups or directed by the FAA and SAE, who sets the standards for deicer quality and performance.

Cryotech was the first deicing company to introduce a next generation deicer, Cryotech BX36® which addresses current pavement deicing concerns such as catalytic oxidation of carbon brakes, corrosion of cadmium corrosion of aircraft parts and electrical conductivity in the airfield. In response to the 2008-2009 potassium acetate deicer shortage, Cryotech developed two new bio-based liquid Runway deicers, Cryotech NX360™ and Cryotech XT360™.

As highlighted in the above examples, Cryotech invests heavily in R&D and takes great pride in the success of recently introduced innovations. Involvement in industry organizations, participation in industry events and constant communication with customers, keeps Crytoech's commitment to new product design and innovation very strong. Customer feedback on deicing needs is welcomed, valued, and greatly appreciated.

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com

State of West Virginia

VENDOR PREFERENCE CERTIFICATE

Certification and application* is hereby made for Preference in accordance with ***West Virginia Code***, §5A-3-37. (Does not apply to construction contracts). ***West Virginia Code***, §5A-3-37, provides an opportunity for qualifying vendors to request (at the time of bid) preference for their residency status. Such preference is an evaluation method only and will be applied only to the cost bid in accordance with the ***West Virginia Code***. This certificate for application is to be used to request such preference. The Purchasing Division will make the determination of the Resident Vendor Preference, if applicable.

1. **Application is made for 2.5% resident vendor preference for the reason checked:**
   ____ Bidder is an individual resident vendor and has resided continuously in West Virginia for four (4) years immediately preceding the date of this certification; **or,**
   ____ Bidder is a partnership, association or corporation resident vendor and has maintained its headquarters or principal place of business continuously in West Virginia for four (4) years immediately preceding the date of this certification; or 80% of the ownership interest of Bidder is held by another individual, partnership, association or corporation resident vendor who has maintained its headquarters or principal place of business continuously in West Virginia for four (4) years immediately preceding the date of this certification; **or,**
   ____ Bidder is a nonresident vendor which has an affiliate or subsidiary which employs a minimum of one hundred state residents and which has maintained its headquarters or principal place of business within West Virginia continuously for the four (4) years immediately preceding the date of this certification; **or,**

2. **Application is made for 2.5% resident vendor preference for the reason checked:**
   ____ Bidder is a resident vendor who certifies that, during the life of the contract, on average at least 75% of the employees working on the project being bid are residents of West Virginia who have resided in the state continuously for the two years immediately preceding submission of this bid; **or,**

3. **Application is made for 2.5% resident vendor preference for the reason checked:**
   ____ Bidder is a nonresident vendor employing a minimum of one hundred state residents or is a nonresident vendor with an affiliate or subsidiary which maintains its headquarters or principal place of business within West Virginia employing a minimum of one hundred state residents who certifies that, during the life of the contract, on average at least 75% of the employees or Bidder's affiliate's or subsidiary's employees are residents of West Virginia who have resided in the state continuously for the two years immediately preceding submission of this bid; **or,**

4. **Application is made for 5% resident vendor preference for the reason checked:**
   ____ Bidder meets either the requirement of both subdivisions (1) and (2) or subdivision (1) and (3) as stated above; **or,**

5. **Application is made for 3.5% resident vendor preference who is a veteran for the reason checked:**
   ____ Bidder is an individual resident vendor who is a veteran of the United States armed forces, the reserves or the National Guard and has resided in West Virginia continuously for the four years immediately preceding the date on which the bid is submitted; **or,**

6. **Application is made for 3.5% resident vendor preference who is a veteran for the reason checked:**
   ____ Bidder is a resident vendor who is a veteran of the United States armed forces, the reserves or the National Guard, if, for purposes of producing or distributing the commodities or completing the project which is the subject of the vendor's bid and continuously over the entire term of the project, on average at least seventy-five percent of the vendor's employees are residents of West Virginia who have resided in the state continuously for the two immediately preceding years.

Bidder understands if the Secretary of Revenue determines that a Bidder receiving preference has failed to continue to meet the requirements for such preference, the Secretary may order the Director of Purchasing to: (a) reject the bid; or (b) assess a penalty against such Bidder in an amount not to exceed 5% of the bid amount and that such penalty will be paid to the contracting agency or deducted from any unpaid balance on the contract or purchase order.

By submission of this certificate, Bidder agrees to disclose any reasonably requested information to the Purchasing Division and authorizes the Department of Revenue to disclose to the Director of Purchasing appropriate information verifying that Bidder has paid the required business taxes, provided that such information does not contain the amounts of taxes paid nor any other information deemed by the Tax Commissioner to be confidential.

Under penalty of law for false swearing (West Virginia Code, §61-5-3), Bidder hereby certifies that this certificate is true and accurate in all respects; and that if a contract is issued to Bidder and if anything contained within this certificate changes during the term of the contract, Bidder will notify the Purchasing Division in writing immediately.

Bidder: _____ **Signed:** _____

Date: _____ **Title:** _____

**Check any combination of preference consideration(s) indicated above, which you are entitled to receive.*

Cryotech Deicing Technology

a division of General Atomics International Services Corporation

(a wholly owned subsidiary of General Atomic Technologies Corporation)

www.cryotech.com www.ga.com

Incorporated: Delaware
December 4, 1987
Registration #2145419

Parent: General Atomic Technologies Corporation (inc. in WY 2/26/86)
3550 General Atomics Court
San Diego, CA 92121-1194
Fed-ID #83-0278510

Federal ID #:	33-0270225	(GAISC)
Sales Tax Exempt #:	1-56-011655	(Cryotech)
Dun & Bradstreet #:	85-918-1984	(GATC)
	80-807-9529	(GAISC)
	94-676-7308	(GAISC - Cryotech)
NAICS Code:	325998	Cage Code: 0S095
SIC Code:	2899	

Remit to address: (**for customers**)
Cryotech Deicing Technology
Dept. LA 23065
Pasadena, CA 91185-3065

SHIP TO/BILL TO:
Cryotech Deicing Technology
6103 Orthoway
Fort Madison, IA 52627-9412

Wiring Instructions: Bank of the West
1280 Fourth Avenue
San Diego, CA 92101-4206
Cryotech Deicing Technology
Checking Account #7490-03182
ABA routing #121100782

For foreign wires Swift Code = BWSTUS66

updated 1/21/09 mlp

Cryotech Deicing Technology

a division of General Atomics International Services Corporation

(a wholly owned subsidiary of General Atomic Technologies Corporation)

Trade References

Altorfer, Inc.
2600 6th Street, SW
Cedar Rapids, IA 52404
(319) 365-0551 phone
(319) 365-5639 fax
Contact: Ted Lawler

Crescent Electric Supply Co.
1001 N. Roosevelt
Burlington, IA 52601
(319) 752-3631 phone
(319) 752-4726 fax

Erco Worldwide
101 State Hwy. 73 South
Nekoosa, WI 54457
(715) 887-4575 phone
(416) 234-7435 fax
Contact: John Keough
Email: jkeough@ercoworldwide.com

Jumbo Sack/Cratex Corp.
2677 Metro Boulevard
Maryland Heights, MO 63043
(314) 291-7777 phone
(314) 291-0045 fax
Contact: Michael Reynoso

Potterfield Trucking
R.R. 1, Box 225A
Monroe City, MO 63456
(573) 735-4528 phone
(573) 735-4399 fax
Contact: Phillip Potterfield

BP Chemicals
150 W. Warrenville Road
Naperville, IL 60563-8460
(877) 701-2726 phone
(630) 961-7800 fax
Contact: Lou Williams

Bank Reference

Union Bank of California
530 B Street #400
San Diego, CA 92186
(619) 230-3380 phone
(619) 230-3766 fax
Contact: Glenn Fortin
Obligor #3098704201

ACORD CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 04/13/2009

PRODUCER
Marsh Risk & Insurance Services
4445 Eastgate Mall, Suite 300
San Diego, CA 92121-1979
858-552-4200
Attn: sandiego.certrequest@marsh.com
034348-10206--O9/10

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED
Cryotech Deicing Technology
A Division of General Atomics International Services Corp.
General Atomic Technologies Corporation
P. O. Box 85608
San Diego, CA 92186-5608

INSURERS AFFORDING COVERAGE	NAIC #
INSURER A: Lexington Insurance Company	19437
INSURER B: Hartford Fire Insurance Co	19682
INSURER C: Allied World Assurance Company (U.S.) Inc.	19489
INSURER D: New Hampshire Insurance Company	23841
INSURER E: American Guarantee & Liability Ins Co	26247

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	ADD'L INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A		GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS MADE X OCCUR X $500,000 SIR GENERAL AGGREGATE LIMIT APPLIES PER X POLICY PRO-JECT LOC	065302511	02/28/09	02/28/10	EACH OCCURRENCE DAMAGE TO RENTED PREMISES(Ea occurence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,500,000 $ 100,000 $ Excluded $ 1,500,000 $ 1,500,000 $ 1,500,000
B		AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS X HIRED AUTOS X NON-OWNED AUTOS	72UENHY3314	02/28/09	02/28/10	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $
		GARAGE LIABILITY ANY AUTO				AUTO ONLY - EA ACCIDENT OTHER THAN AUTO ONLY: EA ACC AGG	$ $ $
C		EXCESS/UMBRELLA LIABILITY OCCUR CLAIMS MADE DEDUCTIBLE RETENTION $	C011537-001	02/28/09	02/28/10	EACH OCCURRENCE AGGREGATE SIR $10,000	$ 4,500,000 $ 4,500,000 $
D F		WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? If yes, describe under SPECIAL PROVISIONS below	WC1871817 Z066604605 (CA)	12/01/08 12/01/08	12/01/09 12/01/09	X WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ 1,000,000 $ 1,000,000 $ 1,000,000
E		OTHER Property All Risk Replacement Cost	ERP3086919-08	02/28/09	02/28/10	Total Property Limit Business Pers Prop Included Deductible	100,000,000 100,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS
EVIDENCE OF INSURANCE

CERTIFICATE HOLDER LOS-000773704-35

CRYOTECH/GENERAL ATOMICS
6103 ORTHOWWAY RR43
FT. MADISON, IA 52627

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE of Marsh USA Inc.
K. McKenna

ADDITIONAL INFORMATION

LOS-000773704-35

DATE (MM/DD/YY)
04/13/2009

PRODUCER

Marsh Risk & Insurance Services
4445 Eastgate Mall, Suite 300
San Diego, CA 92121-1979
858-552-4200
Attn: sandiego.certrequest@marsh.com
034348-10206--09/10

INSURED

Cryotech Deicing Technology
A Division of General Atomics International Services Corp.
General Atomic Technologies Corporation
P. O. Box 85608
San Diego, CA 92186-5608

INSURERS AFFORDING COVERAGE	NAIC #
INSURER F: Zenith Insurance Company	13269
INSURER G:	
INSURER H:	
INSURER I:	

TEXT

CERTIFICATE HOLDER

CRYOTECH/GENERAL ATOMICS
6103 ORTHOWWAY RR43
FT. MADISON, IA 52627

AUTHORIZED REPRESENTATIVE
of Marsh USA Inc.
K. McKenna

Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2008

This is to certify that:

Cryotech Deicing Technology
6103 Orthoway
Fort Madison
Iowa
52627
USA

Holds Certificate No: **FM 39092**
and operates a Quality Management System which complies with the requirements of ISO 9001:2008 for the following scope:

The development, production and sales of environmentally benign deicing materials.

For and on behalf of BSI:

President, BSI Management Systems America, Inc.

Originally Registered: **03/12/1998** Latest Issue: **06/17/2009** Expiry Date: **07/23/2012**

Management Systems

Certificate of Registration

ENVIRONMENTAL MANAGEMENT SYSTEM - ISO 14001:2004

This is to certify that:

Cryotech Deicing Technology
6103 Orthoway
Fort Madison
Iowa
52627
USA

Holds Certificate No: **EMS 89384**
and operates an Environmental Management System which complies with the requirements of ISO 14001:2004 for the following scope:

The development, production and sales of environmentally benign delcing materials.

For and on behalf of BSI:

Gary L Pearson

President, BSI Management Systems America, Inc.

Originally Registered: **07/12/2005** Latest Issue: **07/12/2008** Expiry Date: **07/11/2011**

Management Systems

CRYOTECH

Cryotech Deicing Technology is certified to ISO 9001:2008 and 14001:2004 standards. Customers often ask why these certifications are important enough to be made part of bid specifications. This document attempts to answer that question.

What is ISO?

The abbreviation "ISO" stands for International Organization for Standardization. ISO is a series of international standards introduced in 1987 that define and structure a company's management systems. These standards apply equally to all industries and require companies seeking certification to define how their systems meet the standards' rigorous requirements. Meeting the standards assures customers that all vendor company activities – design, manufacturing, production, purchasing, quality control, packaging, handling, storage, shipping, and customer service – are appropriately managed and controlled.

What is the difference between ISO 9000 and 14000?

ISO 9000 is concerned with "quality management." This means what the organization does to enhance customer satisfaction by meeting customer and applicable regulatory requirements and continually improving its performance in this regard.

ISO 14000 is primarily concerned with "environmental management." This means what the organization does to minimize harmful effects on the environment caused by its activities and continually improving its environmental performance.

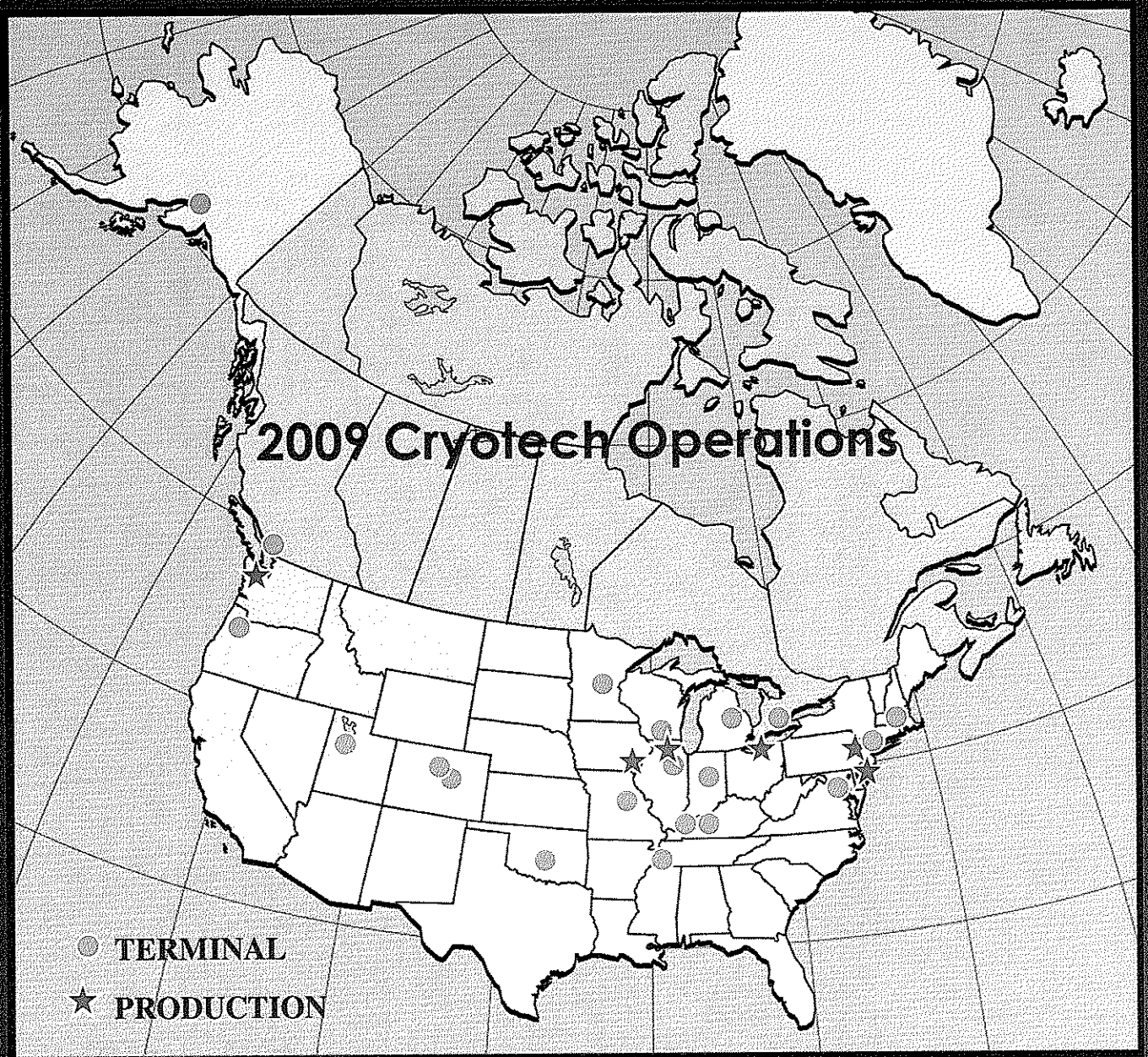
Can any vendor be ISO-certified?

Yes. There are approximately 250,000 companies worldwide registered to ISO standards. Any company willing to make the effort can be certified.

Why should I require vendors to be ISO-certified?

- ISO is direct evidence of a company's financial and ethical commitment to provide high quality, safe products.
- ISO certified companies maintain comprehensive internal audit programs that demonstrate to customers the effectiveness of their quality and environmental efforts.
- ISO certified companies utilize systems that have been accepted for use by over 80 countries as effective means to achieve product quality and environmental stewardship.
- ISO certified companies document, review, and approve product designs that meet applicable safety, regulatory, and customer requirements.
- ISO certified companies prove their systems through audits by independent registrars. Registrars are governed by strict international codes that dictate operating practices, audit methods, and staff qualifications. Failure to maintain quality program requirements will lead to de-certification by the registrar.
- ISO certified company products reduce the need for the buyers to perform audits and reviews to determine if quality systems are in place and being maintained.
- A certificate of analysis from an ISO certified company will be supported by documented procedures and records that demonstrate its validity. This is particularly important should a customer ever have a reason to question product quality.

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com



CRYOTECH

CRYOTECH

CRYOTECH ORDER PROCEDURE

Orders for the following Cryotech products should be placed as shown below.

CUSTOMER NAME: LOCATION(S):

CRYOTECH PRODUCTS (applicable products checked)

- ☐ Kilfrost ABC-S and ABC-S Plus Type IV Aircraft Fluids
- ☐ Kilfrost DF Plus (88) Type I Aircraft Fluid, Dilute and/or Concentrate
- ☐ E36 Liquid Runway Deicer
- ☐ Lavatory Antifreeze
- ☐ NAAC Commercial Deicer
- ☐ NAAC Solid Runway Deicer
- ☐ NX360 Liquid Runway Deicer
- ☐ XT360 Liquid Runway Deicer
- ☐ Other

ORDER PROCESS

Normal business hours: 7:30 a.m. to 4:00 p.m., Monday through Friday

Account Representative: Email:

- Call Cryotech at **800-346-7237** or **319-372-6012**. Cryotech will need to know:
  a. Product that you are ordering
  b. Delivery location address
  c. Requested delivery date and receiving hours
  d. Receiving location contact & phone number for delivery confirmation or questions
  e. Quantity requested
  f. Requestor name and P.O. number
  g. Other special delivery or receiving requirements (fittings, hose, etc.)

After normal business hours or during holidays: (pagers used Nov. 1 thru March 31st)

- Call Cryotech at 800-346-7237 to reach our after hours voice mail system. You will then have the option to "press 1" to reach our answering service who will then page a Cryotech customer service contact. Or, if you do not need to place an order, you may leave a voice mail message that will be picked up on the next business day. (If you call 319-372-6012 after hours, it is picked up by our answering service direct without going into our voice mail system.)

- If after 30 minutes, you have not received a response, call Cryotech's answering service on their line at 866-581-8964. The answering service has additional pager numbers, all employee home phone numbers, and instructions to call until they reach someone.

- Finally, if none of the above options have put you in touch with Cryotech, call Cryotech cellular numbers as listed below.

CRYOTECH	CONTACTS	Cellular	Office
After Hours	**800-346-7237 or as below**		
Cust. Srvc	Various	319-470-4631	800-346-7237 or as below
	Roxanna Huffman	319-470-4784	319-372-6012
	Lisa Parker	515-770-5665	319-372-6012
	Calean David	515-867-0524	319-372-6012
Technical	John Moles	319-371-7238	319-372-6012

Cryotech can also be reached, on a non-emergency basis, by e-mail to deicers@cryotech.com.

NOTE: Schutz style totes (8 minimum) may be picked up when empty by calling 888-724-8389.

CUSTOMER PROFILE

CUSTOMER:	ACCPAC CODES:	Underline one:	GSA?
	Bill to: Ship to	Gov't Airport Commercial Distributor	☐Yes-☒No

SHIPPING RECAP NAME:

STANDING ORDER:

AGREEMENT/CONTRACT :

ORDERS & DELIVERY REQUIREMENTS:

Need pumps &/or hoses_____ On-site storage tanks?_____ Capacity?_____ Tanks cs / ss / poly / other

BILL TO:

SHIP TO:

SHIP FROM:

FM if time allows

Terminal name:
Product:
Contract: within hours
Terminal name:
Product:
Contract: within hours

RECEIVING PH:
FAX:
RECEIVING HRS:
RECEIVING CONTACT(S):
OTHER CONTACTS:
E-mail:

PRICE INCREASE OPTION:

PRODUCTS AND PRICING:

LINE OF CREDIT:

INVOICING NOTES:

CUSTOMER PROFILE

TAX INFORMATION:

Taxable/Tax rate at %
Taxable/Not registered
Not taxable – exemption certificate received –

Type of Exemption:
Cryotech registered in this state yes no

MISCELLANEOUS:

CUSTOMER TRAINING:

Field Training/Tech. Briefing

Last Visit to Customer: By:

MX

ECOBULK MX

SCHÜTZ
INDUSTRIAL PACKAGING

The perfect solution for filling goods with high density.

The ***ECOBULK MX***, with integrated bottom plate, offers superior stability and best protection to the inner container. Additional distinguishing features of the high-quality IBC system are easy discharge of contents and outstanding service life. ECOBULK MX components are made, without exception, for reconditioning and thereby meet the demand for multi-trip capabilities of transport packaging.

MATERIAL

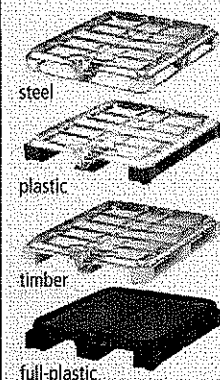
Inner container
- extrusion blow-moulded HDPE
- SMP protective barrier on request

Outer jacket
- welded tubular steel grid
- galvanized

Bottom plate
- made of steel plate to provide stability and to facilitate easy removal of residuals of the inner container

PALLETS

4-way entry



steel
plastic
timber
full-plastic

CERTIFICATIONS

UN 31 HA1/Y FDA
- with wooden pallet **max. density 1.9**
- with plastic pallet **max. density 1.9**
- with steel pallet **max. density 1.9**
- with full-plastic pallet **max. density 1.9**

CAPACITIES

MX 640
640 litre (170 gal)

MX 820
820 litre (220 gal)

MX 1000
1,000 litre (275 gal)

MX 1250
1,250 litre (330 gal)

FILLING OPENING

- DN 150 with screw cap
- DN 225 with screw cap
- DN 400 with clamp-ring lid

OUTLET VALVES

- integrated butterfly valve DN 50
- threaded butterfly valve DN 50 or DN 80, DN 150 also available
- threaded ball valve DN 50

DIMENSIONS

MX 640
1,200 x 800 x 1,000 (L x B x H)

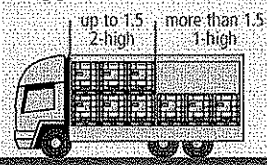
MX 820
1,200 x 1,000 x 1,000 (L x B x H)

MX 1000
1,200 x 1,000 x 1,160 (L x B x H)

MX 1250
1,200 x 1,000 x 1,350 (L x B x H)

DYNAMIC LOAD

Filled ECOBULKs according to specific weight of the filling goods



WEIGHT

MX 640
55 kg (TP), 51 kg (PP), 46 kg (SP)

MX 820
61 kg (TP), 57 kg (PP), 54 kg (SP)

MX 1000
66 kg (TP), 63 kg (PP), 59 kg (SP), 64 kg (FPP)

MX 1250
75 kg (TP), 72 kg (PP), 68 kg (SP)

STATIC LOAD

max. 4-high

MX

ECOBULK MX

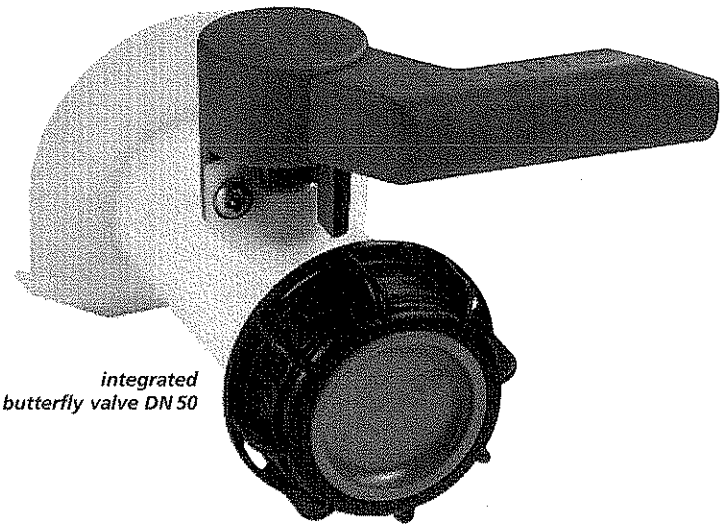
SCHÜTZ
INDUSTRIAL PACKAGING

The ECOBULK MX offers the greatest possible volume in the minimum of space. The IBC system is designed for the safe transport of hazardous goods up to the specific weight of 1.9. Quick to fill, easy to stack, easy to load.

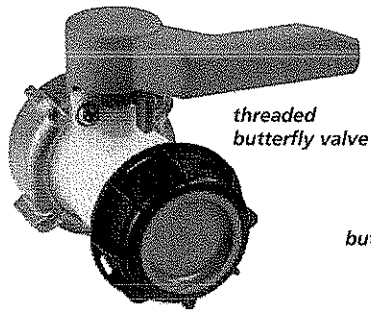
The outlet valves from SCHÜTZ.

User-oriented outlet valves ensure safe and ***precise control of discharging filling goods of various viscosities.*** A large selection of sealing materials provide resistance to various fittings of most filling mediums.

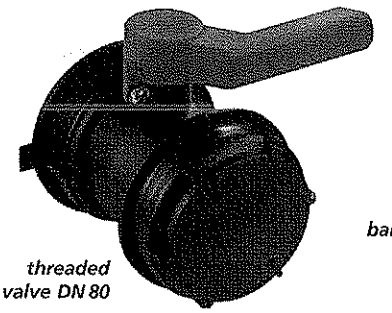
In addition to environment-friendly production of transport containers the ***SCHÜTZ TICKET SERVICE*** significantly contributes to the conservation of resources and to the protection of natural foundations of life: by means of conserving raw materials our unique collection and reconditioning system relieves the strain on our environment.



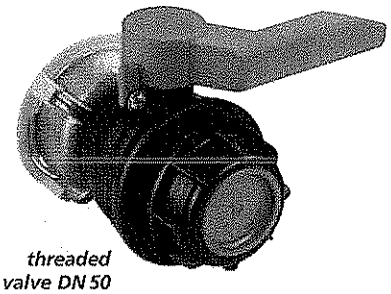
integrated butterfly valve DN 50



threaded butterfly valve DN 50



threaded butterfly valve DN 80



threaded ball valve DN 50

SCHÜTZ (UK) Ltd.
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Fax (+44) 1909-478864

SCHÜTZ France S.A.R.L.
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Fax (+33) 1-64493044

SCHÜTZ Iberica S.L.
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E-43480 Vilaseca (Tarragona)
INDUSTRIAL PACKAGING
Phone (+34) 977-391023
Fax (+34) 977-391063
ENERGY SYSTEMS
Phone (+34) 977-394190
Fax (+34) 977-391299

SCHÜTZ (Italia) S.r.l.
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Fax (+48) 22-8680440

SCHÜTZ Nordic AS
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Fax (+47) 62-822751

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Townamore, Killala
IRL-Co. Mayo
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Fax (+353) 9633045

Headquarters USA
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Edo. de Mexico
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Fax (+1) 877-290-8648

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Argentinas S.A.
Ruta 5 Km. 75
6707-Jauregui-Buenos Aires
Argentina
Phone (+54) 2323-497-596
Fax (+54) 2323-497-844

SCHÜTZ do Brasil
Rua João Batista
Nogueira 550- parte
07231-410 - Guarulhos-
São Paulo
Phone (+55) 116412-5177
Fax (+55) 116412-3331

Furukawa Altec Co., Ltd.
Furukawa Electric Kanda Bld.
2-16-8 Uchikanda Chiyoda-Ku
Tokyo 101-0047, Japan
Phone (+81) 3-5295-4050
Fax (+81) 3-5295-4503

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Fax (+61) 893366052

SCHÜTZ GmbH & Co. KGaA
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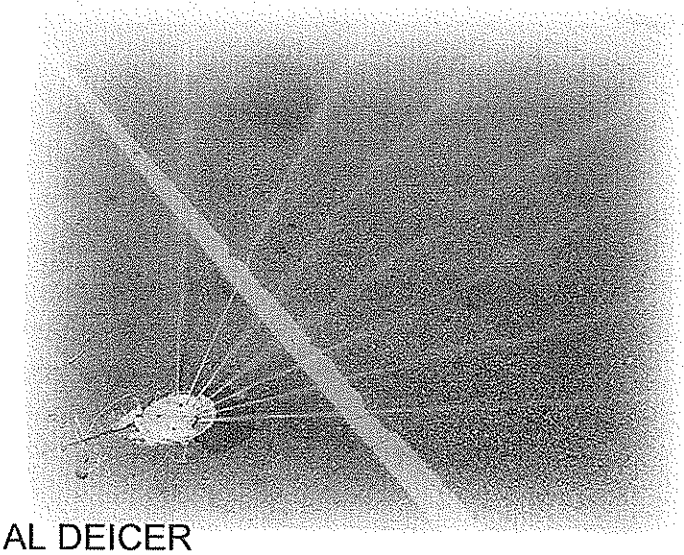
D-97209 Veitshöchheim
Phone +49 (0) 2626/77-0
Fax +49 (0) 2626/77-265
E-Mail: info@schuetz.net
www.schuetz.net

CRYOTECH



Replace the Deicer, Not the Structure

Spec: Cryotech CF7®

LIQUID COMMERCIAL DEICER

BENEFITS

- Low corrosion: non-chloride based
- Fast: liquid formulation works on contact
- High performance: effective to temperatures below -29°C (-20°F)
- Easy to handle: clear liquid, no agitation required
- Safe for the environment: non-persistent, readily biodegradable
- Multi-purpose: anti-icing, deicing, and prewetting solids
- Does not track like common deicers
- Is not slippery like common deicers

PERFORMANCE

- Has low freeze point of -76°F (-60°C)
- When used as an anti-icer - prevents adhesion of snow/ice to pavement
- When used as a deicer - breaks snow/ice bonds prior to mechanical removal
- Does not refreeze as fast as common deicers - the residual effect requires fewer applications

APPLICATION

- Prewetting: apply at spreader outlet at a rate of 1.25 gallons per 100 lbs of solid deicer (130g/kg)
- Deicing:
  Commercial = 1-3 gallons/1000ft^2 (50-150 g/m^2) Highway = 60-180 gallons/lane mile (50-150g/m^2)
- Anti-icing:
  Commercial = 0.5 gallons/1000ft^2 (25-50 g/m^2) Highway = 25-60 gallons/lane mile (25-50g/m^2)
- Re-apply when new snow/ice accumulation shows first tendency to bond
- Plow promptly to reduce fluid dilution

ENVIRONMENT

- Readily biodegrades
- Low BOD
- Does not contain nitrogen, sodium, or chlorides
- Recognized as "relatively harmless" by the U.S. Fish and Wildlife scale

BSI

ISO 9001
FM 39092

HANDLING

- CF7 should not be stored or plumbed through systems that use galvanized, zinc, or brass components
- Polyethylene containers are preferred, otherwise use carbon, low alloy, or stainless steel
- Best practices include storing totes and drums in areas protected from weather and exposure to direct sunlight
- Containers must be clean and free of rust, surface deposits, and residue

BSI

ISO 14001
EMS 89384

See Reverse Side For Product Specifications
Complete Technical Brochure Available Upon Request

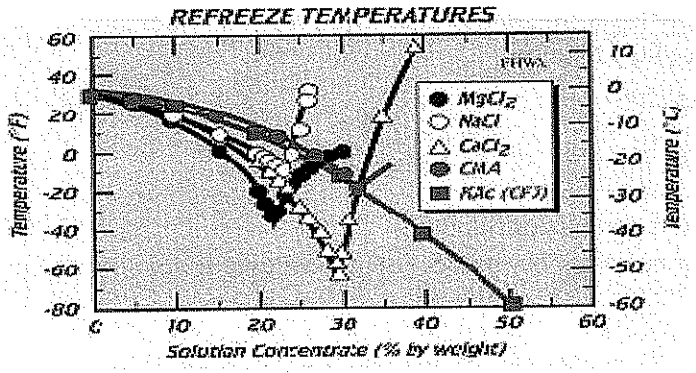
PRODUCT SPECIFICATIONS:

CRYOTECH CF7®

COMPOSITION	50% aqueous potassium acetate solution, by weight, plus corrosion inhibitors
APPEARANCE	Clear, colorless*, mobile liquid, free from matter in suspension
DENSITY	At 20°C (68°F) = 10.7 lbs/gallon (1.28 g/cm^3)
VISCOSITY	At 20°C (68°F) = 10cp maximum At 0°C (32°F) = 20cp maximum
FLASH POINT	Nonflammable
FREEZING POINT	-60°C (-76°F)
MISCIBILITY WITH WATER	Complete
STORAGE	CF7 should not be stored or plumbed through systems that use galvanized, zinc, or brass components
TYPICAL pH	11.0 ± 0.5
SPECIFIC GRAVITY	At 20°C = 1.25 - 1.30
PACKAGING	55 gallon drums (208 liters) - (4 minimum) 265 gallon tote (1003 liters) - (1 minimum) Bulk - (4400 gallons minimum)

*MAY BE DYED BLUE AT CUSTOMER REQUEST

Phase Diagrams of Deicers



Revised - 6/09

TO ORDER OR FOR PRODUCT INFORMATION CONTACT:
Ph: +1 319.372.6012 or +1 800.346.7237 Fax: +1 319.372.2662 E-mail: deicers@cryotech.com

Cryotech Deicing Technology . 6103 Orthoway . Fort Madison, IA . 52627 . WWW.CRYOTECH.COM

CRYOTECH CF7®
MATERIAL SAFETY DATA SHEET

1. PRODUCT NAME & DESCRIPTION

Cryotech CF7® Liquid Deicer

MANUFACTURED AND SUPPLIED IN THE USA BY
Cryotech Deicing Technology
6103 Orthoway
Fort Madison, IA 52627
United States

Cryotech Contact Information
Telephone: (800)346-7237
FAX: (319)372-2662
email: deicers@cryotech.com
website: http://www.cryotech.com

2. CHEMICAL COMPOSITION
The percent compositions are given to allow for the various ranges of the components present in the whole product and may not equal 100%.

Percent	Component	CAS#
100%	Cryotech CF7®	
Containing		
50%	Potassium Acetate	127-08-2
<1.0%	Corrosion Inhibitors in	
50%	Water	7732-18-5

CAS - Chemical Abstract Service Number

3. HAZARD IDENTIFICATION
(also see Sections 11 and 12)

CAUTION! - MAY CAUSE EYE IRRITATION

EYE CONTACT:
This substance is slightly irritating to the eyes and could cause prolonged (days) impairment of your vision. The degree of the injury will depend on the amount of material that gets into the eye and the speed and thoroughness of the first aid treatment. Signs and symptoms may include pain, tears, swelling, redness and blurred vision.

SKIN IRRITATION:
This substance is not expected to cause prolonged or significant skin irritation.

DERMAL TOXICITY:
The systematic toxicity of this substance has not been determined. However, it should be practically non-toxic to internal organs if it gets on the skin.

RESPIRATORY/INHALATION:
This material does not present an inhalation hazard.

INGESTION:
If swallowed, this substance is considered practically non-toxic to internal organs. Ingestion may cause irritation of the digestive tract which may result in nausea, vomiting and diarrhea.

This product contains potassium salts. Ingestion of large amounts (25 or more grams) of potassium salts usually causes a person to vomit. If the person is not suffering from a preexisting kidney condition, the absorbed potassium is rapidly excreted in the urine. However, very young children or individuals with compromised kidney and/or cardiac function could experience the following effects after ingesting excessively large doses of potassium salts: irritation and inflammation of the stomach lining, muscular weakness, burning, tingling and numbness sensations of hands and feet, slower heart beat, reduced blood pressure, irregular heart beat and cardiac arrest.

OCCUPATIONAL EXPOSURE LIMITS:
None Identified

4. FIRST AID MEASURES

Chemical Emergency: Spill, leak, fire, or accident call
Chemtrec day or night (800)424-9300;
Outside continental USA call (703)527-3887

EYE CONTACT:
Flush eyes immediately with fresh water for at least 15 minutes while holding the eyelids open. Remove contact lenses if worn. No additional first aid should be necessary. However, if irritation persists, see a doctor.

SKIN CONTACT:
No first aid procedures are required. As a precaution, wash skin thoroughly with soap and water. Remove and wash contaminated clothing.

INHALATION:
Since this material is not expected to be an immediate inhalation problem, no first aid procedures are required.

INGESTION:
If swallowed, give water or milk to drink and telephone for medical advice. DO NOT make the person vomit unless directed to do so by medical personnel. If medical advice cannot be obtained, then take the person and product container to the nearest medical emergency treatment center or hospital.

5. FIRE FIGHTING MEASURES

FLASH POINT: NA
AUTO IGNITION: NA
FLAMMABILITY LIMITS (% by volume in air):
Lower: NA Upper: NA Non-flammable
EXTINGUISHING MEDIA:
NA - Material is not flammable
FIRE FIGHTING PROCEDURES:
This material normally will not burn.
COMBUSTION PRODUCTS:
Normal combustion forms carbon dioxide and water vapor.
NFPA RATINGS:
Health 1; Flammability 0; Reactivity 0; Special NDA:
(Least - 0, Slight - 1, Moderate - 2, High - 3, Extreme - 4)
These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint Coating Association.

6. ACCIDENTAL RELEASE MEASURES

Chemical Emergency: Spill, leak, fire, or accident call
Outside continental USA call (703)527-3887
Chemtrec day or night (800)424-9300;

Contain spillage and absorb on suitable material e.g. sawdust, sand or earth. Transfer to a container for disposal. See section 13.
Wash the spillage area with plenty of water.

7. HANDLING AND STORAGE

Avoid contact with skin and eyes.
Avoid breathing mists when spraying.
Store in clean vessels and containers.
Do not store or handle product with systems constructed of wetted parts that have galvanized steel, zinc or brass components.

Cryotech CF7® offers these advantages:

- Low Corrosion -- Non-chloride based
- High Performance -- Effective to -20°F (-29°C)
- Safe for the Environment -- Non-persistent and biodegradable
- Dual Purpose -- For prewetting solids or direct application
- Safe to Use -- Recognized as "relatively harmless" by the US Fish and Wildlife scale
- Easy to Handle -- A clear liquid, no agitation required
- Lasts Longer -- Requires fewer applications

Yosemite National Park, California

Based on the characteristics of CF7, CF7 is neither listed as a hazardous waste, nor does it exhibit any of the characteristics that would cause it to be classified or disposed of as a RCRA hazardous waste. For this and other reasons, CF7 may be considered an important tool in managing environmental issues associated with storm water run-off.

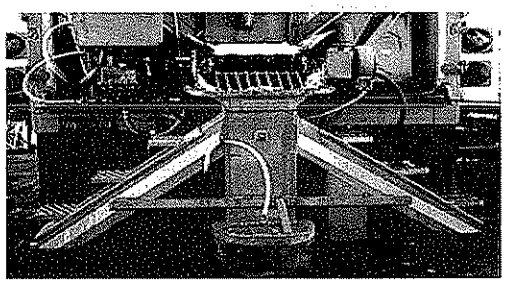
Customer Profile

Zilwaukee Bridge, Saginaw, MI

The Zilwaukee Bridge is essentially corrosion-free. Since completion in 1988, CMA® and CF7 have been the only chemical deicers used on the Zilwaukee Bridge. To date, there is no evidence of chloride-induced corrosion.

Michigan DOT chose CF7 to prewet CMA as it was being applied. When prewet at the time of application, CMA does not bounce and roll, staying on the bridge surface longer. Since CF7 is a high performance deicer, there is an immediate effect. Michigan DOT has also modified equipment for direct application of CF7 for anti-icing and frost conditions.

Potential CF7 customers are typically concerned with deicing speed, environmental issues and/or corrosion. They include transportation officials, public works agencies, property management firms and industrial facilities requiring a high-performance liquid deicer for prewetting primary deicers like road salt and CMA, or sand. CF7 is appropriate for direct application when speed is critical. It is also suitable for use on outdoor mechanical handling systems such as conveyors and elevators, as well as on walkways, rail switches, and virtually all outdoor deicing applications.



Product Specifications

Composition:	50% aqueous potassium acetate solution, by weight, plus corrosion inhibitors
Appearance:	Clear, colorless*, mobile liquid, free from matter in suspension
Density:	At 20°C (68°F) = 10.7 lbs/gallon (1.28 g/cm^3)
Viscosity:	At 20°C (68°F) = 10cp maximum At 0°C (32°F) = 2cp maximum
Flashpoint:	Nonflammable
Freezing Point:	-60°C (-76°F)
Miscibility With Water:	Complete
Storage:	CF7 should not be stored or plumbed through systems that use galvanized, zinc, or brass components
Typical pH:	11.0 +/- 0.5
Specific Gravity:	1.25 - 1.30 at 20°C
Packaging:	55 gallon (208 liters) drum - (4 minimum) 265 gallon (1003 liters) tote - (1 minimum) Bulk - (4400 gallons minimum)

***MAY BE DYED BLUE AT CUSTOMER REQUEST**

For copies of Cryotech product guide specifications call (800)346-7237 or email

Performance

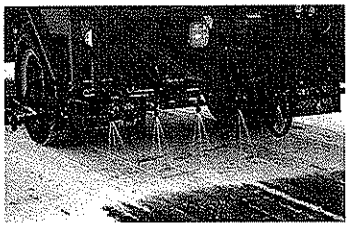
Prewetting Agent

CF7 is an effective prewetting agent for CMA, road salt, other solid deicers, and sand. Because CF7 has a very low freezing point (-60°C / -76°F) and is a clear liquid free from matter in suspension, it significantly improves the performance of solids and does not clog spray nozzles. Application rates follow, and should be considered starting points, as local conditions have a significant effect on fluid requirements.

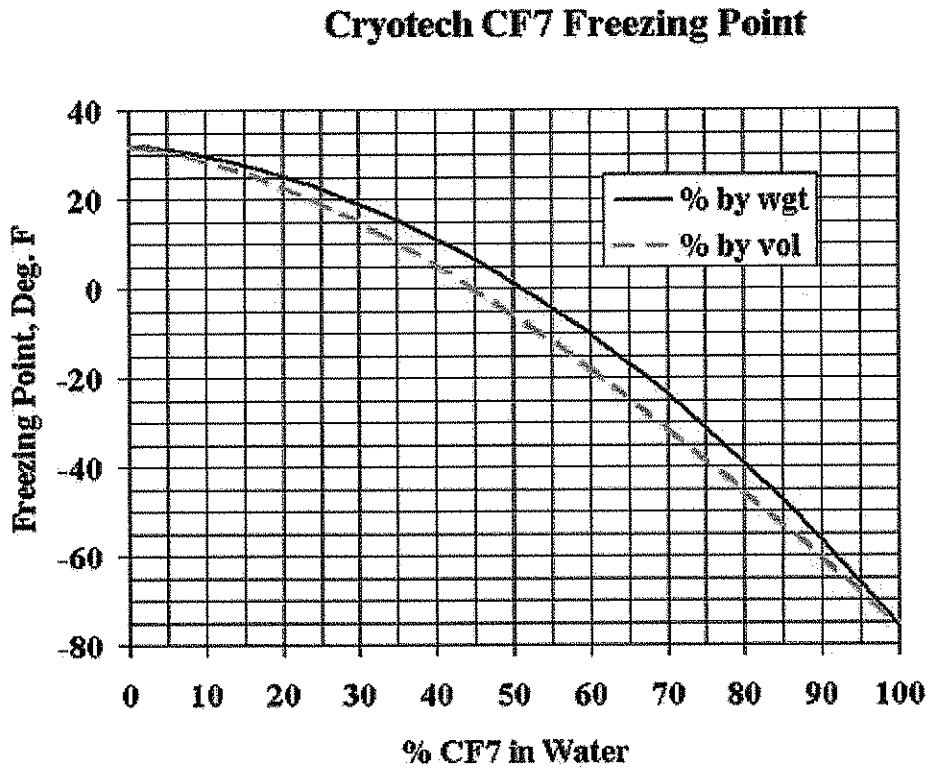
Anti-icer

CF7 is an effective anti-icer, sprayed on the pavement before precipitation actually starts. A high traction film then exists to prevent adhesion of ice and snow, which is then mechanically removed. Uniform coverage and frequent plowing to prevent fluid dilution are important considerations in an anti-icing program. This technique is commonly used to keep bridge decks from freezing.

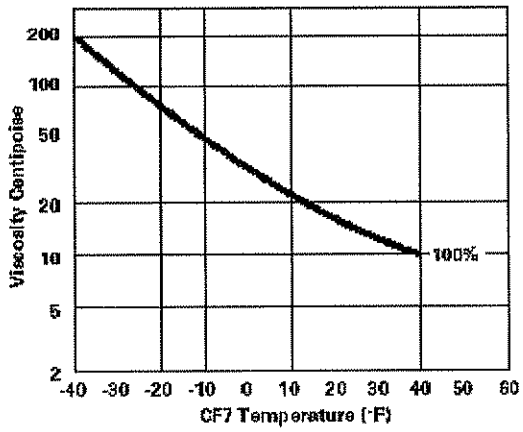
Deicer



Experience suggests that CF7, when used as a deicer, may be applied in an even film or in bands on 4-6 inch (10-15 cm) centers. Banding the fluid minimizes dilution from melting, allowing CF7 to penetrate to the pavement to break the bonds of ice and snow prior to mechanical removal. Suggested application rates follow. CF7 is also used as an aid to solid deicers in heavy ice situations. Here, a solid deicer is first applied to punch holes in the ice. Then, CF7 is applied over the top, penetrating through the holes to the surface, quickly breaking the ice-to-pavement bonds so that mechanical removal can be more easily accomplished.



This freezing point curve will help determine how much dilution CF7 can tolerate before reapplication is necessary to prevent freezing



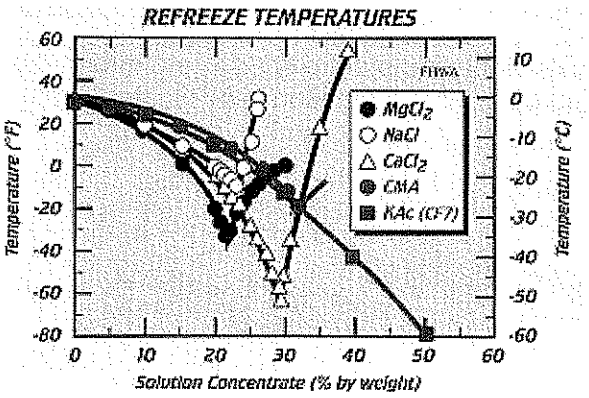
The product viscosity chart will help determine pump requirements in application equipment at various temperatures.

The refreeze temperatures and performance of CMA and KAc (Cryotech CF7®), are addressed in the following excerpt from the **Federal Highway Administration's Manual of Practice for an Effective Anti-icing Program: A Guide for Highway Winter Maintenance Personnel**.

B.4 CMA and KAc (CF7)

The curve for CMA (Figure 17) was determined from different percent concentration solutions made by dissolving commercially available CMA supplied in a dry pellet form. The curve for KAc (CF7) was determined using a commercially available liquid form of KAc (CF7). The eutectic temperature for the CMA water system in Figure 17 is -27.5°C (-17.5°F) at a concentration of 32.5 percent. The eutectic for the KAc (CF7) - water system is -60°C (-76°F) at a concentration of 49 percent. The curves for the CMA and KAc (CF7) almost coincide with each other. Also, they have a much flatter slope than the other three curves. This is an important feature of both CMA and KAc (CF7) solutions. The refreeze temperature of CMA and KAc (CF7) solutions rises slower with dilution than do the refreeze temperatures of either NaCl, CaCl2, or MgCl2. This feature makes them well suited for being used in a liquid form during anti-icing treatments. This is especially true for their use in a liquid form for the pretreatment of bridge decks in anticipation of frosting, or localized icing conditions.

Figure 17



Other Applications

CF7 can also be used to:

- Coat rail and truck beds, non-porous roofs, road signs, etc. so snow and ice do not adhere
- Keep rail switches open
- Free manhole covers, truck scales
- Keep conveyors ice-free
- Keep lavatory systems from freezing.

CF7 is also used in the creation of Cryotech CMAK, a blend of liquid CMA (calcium magnesium acetate) and CF7. CMAK is recommended for use in automated anti-icing systems. Containing no chlorides, it combines the low-corrosion properties of CMA with the high performance of potassium acetates. CMAK has a lower freezing point (<25F) than pure CMA, but retains many of CMA's attributes such as safety for steel embedded in bridge decks and parking garages. See MSDS for additional information.

Corrosion

Because CF7 is acetate based, it is compatible with most materials and is generally considered non-corrosive. Special corrosion inhibitors have been added to provide the same level of protection as E36, Cryotech's airport approved liquid deicer.

Avoid CF7 Use

- On low quality or non air-entrained concrete
- In direct application to galvanized metals
- In close proximity to non-watertight electrical systems
- In mixture with liquid chloride deicers like calcium chloride

Shelf Life

CF7 is stable and may be stored indefinitely if kept in clean, closed containers. Containers not adequately sealed may exhibit biological growth as a result of the fluid prematurely biodegrading. CF7 stored in rusty or contaminated containers may experience a reduction in inhibitor concentration and/or show fluid discoloration.

Environmental Impact

Tests with CF7 show it readily biodegrades at low temperatures and has a relatively low oxygen demand (BOD) when compared to glycol-based deicers. CF7 is recognized as "relatively harmless" by the US Fish and Wildlife scale. In addition, the fluid does not contain nitrogen. Therefore, CF7 is considered much safer for the environment than either glycol or urea.

As suggested by federal agencies, the following general summary of environmental and hazard information is provided. More detail is available in the MSDS. Complete test report documentation is available upon request.

Biodegradability

The chemical oxygen demand (COD) of CF7 was determined using SM 5210B.

- COD (TOD) = 0.32 g 0_2/g deicer

The biological oxygen demand (BOD) of CF7 was determined using SM 5210B.

- BOD_5 @ 68°F = 0.25 g O_2/g deicer

Aquatic Toxicity

Current EPA methods were used for measuring the acute and chronic toxicity of CF7.

- Fathead minnow 7-day chronic, LC50 (mg/L) ..... > 1500
- Rainbow trout 96-hour acute, LC50 (mg/L). ..... > 2100
- Daphnia magna 48-hour acute, LC50 (mg/L) ..... > 3000

Hazard Information

- **Hazardous Waste & Shipping**
  The RCRA regulations define hazardous waste in two ways: a listed hazardous waste or a characteristic hazardous waste. CF7 is not a listed hazardous waste. A waste may be considered hazardous if it exhibits any one of four characteristics - Corrosivity, toxicity, ignitability, or reactivity. A waste is corrosive under RCRA if it has a pH less than or equal to 2.0 or greater than or equal to 12.5. CF7 is not RCRA corrosive, toxic, ignitable or reactive; therefore, it is not a characteristic hazardous waste.

- **No Hazardous Components**
  CF7 contains no hazardous components as described by SARA Title III, Section 302. Nor is CF7 designated as a hazardous chemical by the U.S. Department of Transportation. CF7 does not contain nitrates.
- **Spill Handling Procedures**
  CF7 is not expected to present environmental problems. If product should spill, it should be absorbed and the resulting waste disposed of in a sanitary landfill unless state or local regulations prohibit such disposal.
- **Container and Product Disposal**
  Based on information available to Cryotech Deicing Technology, CF7 is neither listed as a hazardous waste, nor does it exhibit any of the characteristics that would cause it to be classified or disposed of as a RCRA hazardous waste. Empty containers and product unsuitable for normal deicing operations may be disposed of in a sanitary landfill unless state or local regulations prohibit such disposal.

Application Rates

For sprayer or tank assistance, please contact Cryotech at 1-800-346-7237.

Anti-icing

CF7 is most effective when applied uniformly to pavement surface before freezing precipitation. Prompt mechanical removal of snow and ice is necessary to reduce fluid dilution. Additional applications may be necessary if snow and ice begin to bond to the surface.

- Apply.....0.5 gallons/1000 f^2 (25 g/m^2)

Deicing

CF7 is an effective deicer when applied in an even film or in bands on 4-6 inch (10-15 cm) centers. The deicer penetrates to the pavement surface and breaks the bond of ice and snow prior to mechanical removal. Banding reduces dilution from melting and allows the fluid to penetrate. The amount of deicer needed varies with temperature and thickness of snow or ice, but should be in the following ranges.

- Apply on thin ice.....1.0 gallon/1000 f^2 (50 g/m^2)
- Apply on 1" (2.5 cm) ice.....3.0 gallons/1000 f^2 (150 g/m^2)

Prewetting

CF7 will speed the effect of solid deicers and abrasives. CF7 is applied at the spreader outlet, typically for prewetting rates of 5% to 15% by weight of solid material.

- Apply.....1.25 gallons per 100 lbs of deicer or sand (130 g/kg of deicer or sand)

Storage and Transport

The formulation of CF7 contains an inhibitor package designed to protect several metal alloys from accelerated corrosion and deterioration (e.g., cracking). The inhibitor package consists of fully dissolved compounds which, when exposed to metal alloys such as plain carbon or low alloy steels, will form a barrier on the alloy surface to prevent accelerated corrosion.

To maintain the full effectiveness of the inhibitor package Cryotech recommends shipping and storage of CF7 in non-metal containers such as polyethylene. In cases where this is not possible, shipment and storage can be accomplished with carbon, low alloy, or stainless steel containers. Storage and shipment containers should be strong enough to hold 10.68 lbs. per gallon of CF7, which is 28% heavier than water.

Shipping and storage in carbon or low alloy steel containers does not represent a major concern. However, the customer must be aware that this may result in depletion of the inhibitor concentration. The amount of depletion will depend on material composition, surface condition, and surface area.

When shipment or storage in carbon or low alloy containers is necessary, the container must be clean and free of rust and surface deposits. Rust and surface deposits (or scale) may become dislodged or dissolved and result in fluid degradation and discoloration. Additionally, tanks or containers which have been used for other materials must be drained and, at a minimum, rinsed, to remove the material before introducing CF7.

Note: Residue of chloride based deicer (especially CaCl2 and MgCl2) must be removed prior to filling. Avoid galvanized materials in piping and storage systems. Potassium acetate is known to have a relatively slow reaction with zinc-coated materials. This is not an issue for roadway appurtenances where exposure time is limited.

Standard Shipments

CF7 is shipped to customers in the following units:

- Rail Tank Cars.....18,000 gallons (68,000 liters)
- Tank Trucks.....4,400 gallons (16,600 liters)
- Isotanks.....4,000 gallons (15,000 liters)
- Totes.....265 gallons (1,000 liters)
- Drums.....55 gallons (200 liters)

Sampling Procedure

Reference the suggested sampling procedure prior to sending a sample to Cryotech's Quality Assurance Lab. Contact Cryotech with any questions by phone (800)346-7237 or email.

Maintenance Dispensing Equipment

- External surfaces of equipment used to dispense CF7 should be routinely rinsed with warm water or a high-pressure wash to prevent buildup of the fluid and other contaminants associated with winter maintenance operations. A thorough high-pressure washing with warm soapy water is recommended as equipment is removed from service after the deicing season.
- Diluted CF7 biodegrades naturally when exposed to air and other contaminants. This process quickens in warmer temperatures. Frequent rinsings will prevent any buildup that could result in formations of unsightly biological growth and superficial staining and pitting of some material.
- Undiluted CF7 kept in closed containers with minimal exposure to air does not degrade and may be stored indefinitely.

Applying liquid deicers to dry pavement will reduce friction between tires and the pavement surface. For this reason alone, user training is important prior to initial use.

Please contact Cryotech at (800)346-7237 or (319)372-6012, or email.

Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

Non-chloride based Calcium Magnesium Acetate (Cryotech CMA®), Sodium Acetate (Cryotech NAAC®), and Potassium Acetate (Cryotech CF7®) are eligible for matching Federal Funds under the SAFETEA-LU act that was passed in August 2005. Through the SAFETEA-LU act, funds are available for low corrosive anti-icing/deicing applications and environmentally preferred anti-icers/deicers used on highway bridges through 2009. This act is building on the foundation provided by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century of 1998 (TEA-21), which originated to help preserve and rehabilitate America's bridges. There is approximately $21.6 billion authorized through 2009 for the Highway Bridge Program section of the act.

For more information regarding the SAFETEA-LU act, please visit http://www.fhwa.dot.gov/safetealu/index.htm.

Cryotech CF7 Freeze Point Data

% CF7 Solution	s.g. @20C	Freeze Pt. Degrees F	Freeze Pt. Degrees C	% CF7 Solution	s.g. @20C	Freeze Pt. Degrees F	Freeze Pt. Degrees C
0	1.000	32	0	50	1.140	1	-17
1	1.003	32	0	51	1.143	0	-18
2	1.006	32	0	52	1.146	-1	-18
3	1.008	31	0	53	1.148	-2	-19
4	1.011	31	0	54	1.151	-3	-20
5	1.014	31	-1	55	1.154	-5	-20
6	1.017	31	-1	56	1.157	-6	-21
7	1.020	30	-1	57	1.160	-7	-22
8	1.022	30	-1	58	1.162	-8	-22
9	1.025	30	-1	59	1.165	-9	-23
10	1.028	30	-1	60	1.168	-11	-24
11	1.031	29	-2	61	1.171	-12	-24
12	1.034	29	-2	62	1.174	-13	-25
13	1.036	28	-2	63	1.176	-15	-26
14	1.039	28	-2	64	1.179	-16	-27
15	1.042	28	-2	65	1.182	-17	-27
16	1.045	27	-3	66	1.185	-19	-28
17	1.048	27	-3	67	1.188	-20	-29
18	1.050	26	-3	68	1.190	-22	-30
19	1.053	26	-3	69	1.193	-23	-31
20	1.056	25	-4	70	1.196	-24	-31
21	1.059	25	-4	71	1.199	-26	-32
22	1.062	24	-4	72	1.202	-27	-33
23	1.064	24	-5	73	1.204	-29	-34
24	1.067	23	-5	74	1.207	-30	-35
25	1.070	22	-5	75	1.210	-32	-36
26	1.073	22	-6	76	1.213	-33	-36
27	1.076	21	-6	77	1.216	-35	-37
28	1.078	20	-6	78	1.218	-37	-38
29	1.081	20	-7	79	1.221	-38	-39
30	1.084	19	-7	80	1.224	-40	-40
31	1.087	18	-8	81	1.227	-42	-41
32	1.090	18	-8	82	1.230	-43	-42
33	1.092	17	-8	83	1.232	-45	-43
34	1.095	16	-9	84	1.235	-47	-44
35	1.098	15	-9	85	1.238	-48	-45
36	1.101	14	-10	86	1.241	-50	-46
37	1.104	14	-10	87	1.244	-52	-47
38	1.106	13	-11	88	1.246	-54	-48
39	1.109	12	-11	89	1.249	-56	-49
40	1.112	11	-12	90	1.252	-57	-50
41	1.115	10	-12	91	1.255	-59	-51
42	1.118	9	-13	92	1.258	-61	-52
43	1.120	8	-13	93	1.260	-63	-53
44	1.123	7	-14	94	1.263	-65	-54
45	1.126	6	-14	95	1.266	-67	-55
46	1.129	5	-15	96	1.269	-69	-56
47	1.132	4	-15	97	1.272	-71	-57
48	1.134	3	-16	98	1.274	-73	-58
49	1.137	2	-17	99	1.277	-75	-59
50	1.140	1	-17	100	1.280	-77	-60

klj 3/8/00

INTRODUCTION

Northwestern Aquatic Sciences was retained by Chevron Research Corporation to perform biochemical oxygen demand (BOD) and chemical oxygen demand (COD) measurements on eight deicing compounds or formulations at temperatures of 2°C, 10°C, and 20°C. The purpose of the study was to develop comparative information between the test materials with regard to rate and extent of microbial degradation at the three test temperatures. The temperature of 2°C was of particular interest because it most nearly simulates environmental temperatures that might occur at locations and times when deicing substances would be used.

Initially Northwestern Aquatic Sciences proposed to perform studies that did not strictly follow standard BOD methods, but were geared to producing oxygen consumption rate-temperature curves. An initial study was performed with each of the eight test materials at 20°C and lasting seven days. Following consultation with the client after review of the raw data from the initial study, Northwestern Aquatic Sciences was directed to perform the remaining BOD studies using standard BOD methods and times of incubation. Therefore, the results of these initial studies are not reported here, but the notebook raw data are included in Appendix I.

This report describes the results of definitive analyses of COD of each of the eight test materials, and the results of the final BOD study in which 5-day and 20-day BOD values were obtained for each test material at 2°C, 10°C, and 20°C incubation temperatures. The raw data for these studies are listed in Appendices II and III.

MATERIALS AND METHODS

CHEMICAL OXYGEN DEMAND

Chemical oxygen demand (COD) was determined using a micro version of EPA Method 410.1 (EPA 1983). Prior to analysis, aqueous solutions of the test materials were prepared by volumetric dilution of weighed test materials. In the definitive phase of the study, test material stock concentrations were approximately 10 mg/ml (range 9.28 mg/ml for IBG Runway to 10.28 mg/ml for E-36).

The analytical method employed 12 ml teflon capped glass culture tubes as reaction vessels. Five milliliters of a reaction cocktail consisting of 1.25 ml of 0.25 N $K_2Cr_2O_7$, 0.25 ml of concentrated H_2SO_4, 0.05 g of $HgSO_4$, and 3.5 ml of H_2SO_4-$AgSO_4$ reagent was reacted in an oven for 2 hr at 150°C with from 0.025 ml to 0.25 ml of sample and sufficient deionized water to yield a 2.5 ml final sample volume. Blank tubes contained 2.5 ml of deionized water only. After cooling, the reaction mixture was titrated with 0.25 N $Fe(NH_4)_2(SO_4)_2H_2O$ using a microburet to an endpoint using ferroin indicator. All definitive analyses were performed at least in duplicate.

BIOCHEMICAL OXYGEN DEMAND

Biochemical oxygen demand (BOD) was determined using the EPA approved dilution method (Hach 1989). Prior to analysis, aqueous solutions of the test materials

were prepared by volumetric dilution of weighed test materials. In the definitive phase of the study, test material stock concentrations ranged from 1.00 mg/ml for IBG Highway, IBG Runway, UCAR, and E-36 to 50.0 mg/ml for urea. For each test material and each test temperature, four dilutions of these stock solutions were employed ranging from 1 to 10% by volume (3 to 30 ml of test material stock solution in 300 ml).

Incubations were for 5 and 20 days at 2°C, 10°C, and 20°C. Dilution water was seeded with settled municipal sewage at a level of 6.7 ml/L. Prior to incubation, the seeded dilution water was equilibrated to the appropriate incubation temperature and saturated with air by bubbling from an oil-free compressed air source. Hach nitrification inhibitor (0.16 g) was added to each 300 ml BOD bottle.

Results were calculated using the Hach (1989) graphical method. In this method the final dissolved oxygen concentrations are plotted against the test material sample volume and a straight line was fitted to the points. The value where the line intersects the y axis is equal to the dissolved oxygen concentration of a dilution water blank even though this was not measured. The biochemical oxygen demand is calculated using the formula:

$$\text{mg/L BOD} = (\text{slope of line} \times 300) - Y_{intercept} + DO_{init\ sample}$$

In these studies the initial sample DO concentration was not measured, but considering the nature of the samples was assumed to be oxygen saturated at the equilibration (test) temperature. The BOD values were converted to mg BOD/g test material using the formula:

$$\text{mg BOD/g test material} = \text{mg/L BOD (of stock sol'n)} \div \text{g/L (stock conc.)}$$

The calculation worksheets giving the XY plots and the data calculations for each test material-test length-temperature combination for the definitive BOD study are to be found in Appendix III.

Ideally the line should fit at least three points in the XY plot. In many instances, however, particularly at the higher incubation temperatures, oxidation rates were higher than anticipated from the results of the preliminary study (Appendix I) and BODs had to be estimated from the lowest one or two test concentrations only. In these instances considerable judgment had to be employed to obtain the best possible fits, especially when only one point was above the flat part of the curve (between 1-2 mg/L DO). The method involved extending the line from the one usable point through the y axis at a point judged to be at or slightly below the oxygen saturation level at the test temperature employed. Data obtained in this fashion are footnoted in the results table as having employed only one point in the data analysis. In a few instances, even the smallest test sample volume appeared to be at the flat portion of the DO:sample volume curve. In these instances, the BOD was indicated to be $\geq$ the tabulated value which was based on the one point data analysis.

RESULTS

Table 1 lists the results of both the COD and BOD tests expressed in terms of g O_2/g test material. In most instances clear progression of BOD values is observed in the series consisting of low to high temperature, and 5-day to 20-

day incubations. For four compounds, Ice-B-Gon Highway, Ice-B-Gon Runway, UCAR, and E-36, the 20-day 20°C BOD values are reasonably similar to the COD values suggesting that biological oxidation had progressed to the endpoint. There was very little chemical or biochemical oxidation of either Freezgard or urea. The biological oxidation rates of ethylene glycol and propylene glycol appeared slower than for the Ice-B-Gons, UCAR, and E-36 since oxidation appeared to be less than complete by 20 days at 20°C.

LITERATURE CITED

U.S. EPA. 1983. Methods for chemical analysis of water and wastes. EPA-600/4-79-020, Revised March 1983. Environmental Monitoring and Support Laboratory, Cincinnati, OH.

Walters, G.L. (Ed.). 1989. Water analysis handbook. Hach Co., Loveland, CO. 691 pp.

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Table 1. COD and BOD test results for eight deicer compounds.

Compound	COD (g O_2/g)	BOD length (days)	BOD (g O_2/g) 2°C	10°C	20°C
Ice-B-Gon Highway (calcium magnesium acetate)	0.73	5	0.02	0.45	0.46a
		20	0.40	0.67a	0.62a
Ice-B-Gon Runway (calcium magnesium acetate)	0.78	5	--	0.49	0.66a
		20	0.57	0.71a	0.69a
UCAR (ethylene glycol + urea blend)	0.63	5	0.00	0.04	0.09
		20	0.05	0.43a	≥0.76a
Freezgard N/A	0.03	5	0.00	0.01	0.01
		20	0.01	0.01	0.01
E-36 (CF7) (50% potassium acetate by wt.)	0.30	5	0.00	0.15	0.14
		20	0.30	0.25	0.34
Urea	0.01	5	0.00	0.00	0.00
		20	0.00	0.00	0.00
Ethylene Glycol	1.29	5	0.00	0.00	0.10
		20	0.09	≥0.28a	≥0.29a
Propylene Glycol	1.65	5	0.00	0.19	0.63a
		20	0.35a	0.81a	1.06a

[a] Values estimated using only one data point.

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 477-1

Title: Fathead Minnow 7-day larval survival and growth test using static exposure to Cryotech C92/E-36 Deicer. (C92 name changed to CF7 in 1993)

Protocol No.: "Environmental Protection Series Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows", Environment Canada, Report EPS 1/RM/22, February 1992; and NAS-XXX-PP2, September 15, 1990, Revision 1 (10-30-91). Based on U.S. EPA. 1989. Method 1000.0, Fathead minnow, Pimephales promelas, larval survival and growth test, pp. 33-74, In: Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms. Second edition. EPA/600/4-89/001.

STUDY MANAGEMENT

Study Sponsor: Cryotech Deicing Technology, 6103 Orthoway, Fort Madison, IA 52627.

Sponsor's Study Monitor: Mr. Keith L. Johnson

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365.

Test Location: Newport Laboratory.

Laboratory's Study Personnel: R.S. Caldwell, Ph.D., Proj. Man./Study Dir.; L.K. Garrison-Nemeth, B.A., QA Officer; G.A. Buhler, B.S., Aq. Toxicol.; S.B. Noack, B.S., Aq. Toxicol.; B.D. Crowe, B.S., Sr. Tech.; G.J. Irissarri, B.S., Tech.; C.J. Bullock, B.S., Tech.

Study Schedule:

Test Beginning: 12-16-93, 1:00 p.m.

Test Ending: 12-23-93, 12:30 p.m.

Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 334 S.W. 7th Street, Suite B, Newport, OR 97365.

Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations effective December 29, 1983 (40 CFR Part 792).

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Description: Cryotech Deicing Technology, C92/E-36 Deicer. Details are as follows:

NAS Sample No.	0799E
Collection Date	12-9-93
Receipt Date	12-10-93
Conductivity (µmhos/cm)	>20,000
pH	11.3

Treatments: None

Storage: Stored at room temperature in sealed container until tested.

DILUTION WATER

Source: Moderately hard synthetic water prepared from Milli-Q water.
Date of Preparation: 12-14-93, 12-16-93
Pretreatment: Aerated ≥24 hours.

TEST ORGANISMS

Species: Pimephales promelas, fathead minnow.
Age: <24-hr-old.
Source: Aquatox, Hot Springs, Arkansas.
Acclimation: Holding prior to testing were: Temperature, 23.0 ± 1.5°C; dissolved oxygen, 8.2 ± 0.2 mg/L; pH, 7.8 ± 0.1; conductivity, 572 ± 74 µmhos/cm; hardness, 125 ± 49 mg/L as $CaCO_3$; and alkalinity, 130 ± 71 mg/L as $CaCO_3$.

TEST PROCEDURES AND CONDITIONS

Test Chambers: 600 ml glass beakers containing 250 ml of test solutions.
Test Concentrations: 3000, 1500, 750, 375, 188, and 0 mg/L (control)
Replicates/Treatment: 4
Organisms/Treatment: 40
Loading (based on final weight of control organisms): 0.0146 g/L
Water Volume Changes per 24 hr: 1
Aeration: None
Feeding: Approx. 700 Artemia nauplii per beaker three times daily except on day 7.
Effects Criteria: The effect criteria used were: 1) mortality, and 2) growth inhibition. Mortality was defined as lack of visible movement during a 30 second observation period. Growth inhibition was measured as the difference in weight gain of fish between a treatment level and the control.
Water Quality and Other Test Conditions: Temperature, 23.6 ± 0.4°C; dissolved oxygen, 6.5 ± 1.9 mg/L; conductivity, 2,200 ± 71 µmhos/cm (3000 mg/L), 383 ± 58 µmhos/cm (control); pH, 7.7 ± 0.2; hardness, 103 ± 10 mg/L as $CaCO_3$ (3000 mg/L), 96 ± 10 mg/L as $CaCO_3$ (control); alkalinity, 200 ± 0 mg/L as $CaCO_3$ (3000 mg/L), 86 ± 10 mg/L as $CaCO_3$ (control); and photoperiod 16:8 hr, L:D.

DATA ANALYSIS METHODS

Percent survival and the average weight per larva were calculated for each treatment replicate from the raw data and the means were obtained for each treatment level. The LC50 (survival) was calculated by the Trimmed Spearman-Karber method (EPA 600/4-90-027). The IC25 (growth) was calculated using the Linear Interpolation Method with bootstrapping (EPA 600/4-89/001a). NOEC and LOEC values for survival and growth were computed using Dunnett's test, T-Test with Bonferroni's adjustment, Steels Many-One Rank Test, or Wilcoxon Rank Sum Test with Bonferroni Adjustment. The appropriate test was selected after evaluating the data for normality and homogeneity of variance. Weight data at certain treatment levels were excluded from the hypothesis test calculation if there was a survival effect. An arcsine transformation was performed on the survival data prior to statistical analysis. The statistical software employed for these calculations was ToxCalc, v. 4.0, Tidepool Scientific Software.

PROTOCOL DEVIATIONS

1. Cadmium as $CdCl_2$-$2.5H_2O$ was used as the reference toxicant because this was the standard reference toxicant used by the laboratory for the fathead minnow chronic test. Use of this toxicant allowed comparison with the laboratory's QC control chart.

2. On three occasions, the temperature dropped below 23.0°C, the lowest being 22.6°C. The mean ± S.D. of temperature was 23.6 ± 0.4°C. The protocol specifies that temperature should be 25 ± 1°C and the range should be between 23°C and 27°C. The Project Manager determined that these temperature deviations were not likely to have a significant adverse effect on the test results.

REFERENCE TOXICANT TEST

Test No.: 999-309
Reference Toxicant and Source: $CdCl_2$-$2.5H_2O$, Mallinckrodt, Lot No. TNZ.
Test Date: 12-16-93
Dilution Water Used: Moderately hard synthetic water.
Result: 7-day LC50, 24.8 µg/L Cd; 7-day IC25, 14.3 µg/L Cd; NOEC, 10 µg/L Cd.
Control Chart: LC50 (LWL-UWL). 17.8 µg/L (9.49 µg/L - 26.0 µg/L)
IC25 (LWL-UWL). 16.3 µg/L (8.31 µg/L - 24.3 µg/L)
See control charts attached to raw data.

TEST RESULTS

A detailed tabulation of the test results is given in Table 1. The biological effects, given as the NOEC and LOEC for survival and growth, and the LC50/IC25 for survival/growth, are shown below.

	Survival	Growth
NOEC (mg/L)	1500	750
LOEC (mg/L)	3000	1500
7-Day LC50/IC25 (mg/L)	1518	1585
(95% conf. int.)	(1360 - 1694)	(833 - 1712)
Method	Trimmed Spearman-Karber	linear interpolation

STUDY APPROVAL

Study Director 2/28/94 Date

Quality Assurance Unit 3/1/94 Date

Table 1. Survival and growth of fathead minnow larvae exposed for seven days to Crytotech Deicing Technology C92/E-36 deicer.

Test concentration (mg/L)	Repl.	Number of larvae			Percent survival	Mean* percent survival	Ave. wt. per larva (mg)	Mean* weight (mg)
		Exposed	Dead	Surviving				
3000	1	10	10	0	0.0		--	
	2	10	10	0	0.0		--	
	3	10	10	0	0.0		--	
	4	10	10	0	0.0	0.0*	--	--
1500	1	10	3	7	70.0		0.340	
	2	10	6	4	40.0		0.325	
	3	10	7	3	30.0		0.360	
	4	10	5	5	50.0	47.5	0.360	0.346*
750	1	10	2	8	80.0		0.399	
	2	10	0	10	100.0		0.408	
	3	10	1	9	90.0		0.378	
	4	10	0	10	100.0	92.5	0.436	0.405
375	1	10	0	10	100.0		0.419	
	2	10	0	10	100.0		0.424	
	3	10	0	10	100.0		0.436	
	4	10	0	10	100.0	100.0	0.433	0.428
188	1	10	1	9	90.0		0.407	
	2	10	1	9	90.0		0.418	
	3	10	2	8	80.0		0.484	
	4	10	0	10	100.0	90.0	0.421	0.432
Control	1	10	3	7	70.0		0.514	
	2	10	0	10	100.0		0.422	
	3	10	1	9	90.0		0.341	
	4	10	2	8	80.0	85.0	0.465	0.436

* An asterisk next to a treatment mean indicates that it is significantly ($P<0.05$) less than the control mean.

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 477-4

Title: Rainbow trout, Oncorhynchus mykiss, 96-hr acute toxicity test using static exposure to Cryotech C92/E-36 Deicer.

Protocol No.: "Environmental Protection Series Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout". Environment Canada Report EPS 1/RM/13, July 1990; and NAS-XXX-OM1, June 23, 1990, Revision 1 (1-18-92). Based on Peltier and Weber. 1985. Methods for measuring the acute toxicity of effluents to freshwater and marine organisms. EPA/600/4-85/013.

STUDY MANAGEMENT

Study Sponsor: Cryotech Deicing Technology, 6103 Orthoway, Fort Madison, IA 52627.

Sponsor's Study Monitor: Mr. Keith L. Johnson

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, OR 97365.

Test Location: Newport Laboratory

Laboratory's Study Personnel: R.S. Caldwell, Ph.D., Proj. Man./Study Dir.; L.K. Garrison-Nemeth, B.A., QA Officer; G.A. Buhler, B.S., Aq. Toxicol.; G.J. Irissarri, B.S., Sr. Tech.

Study Schedule:

Test Beginning: 12-27-93, 9:00 a.m.

Test Ending: 12-31-93, 10:00 a.m.

Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 334 S.W. 7th Street, Suite B, Newport, OR 97365.

Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations effective December 29, 1983 (40 CFR Part 792).

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Description: Cryotech Deicing Technology, C92/E-36 Deicer. Details are as follows:

NAS Sample No.	0799E
Collection Date	12-9-93
Receipt Date	12-10-93
Conductivity (µmhos/cm)	>20,000
pH	11.3

Treatments: None

Storage: Stored at room temperature in sealed container until tested.

DILUTION WATER

Source: Moderately hard synthetic water prepared from Milli-Q water.
Date of Preparation: 12-26-93
Pretreatment: Aerated ≥24 hours.

TEST ORGANISMS

Species: Oncorhynchus mykiss, rainbow trout.
Size/Weight: 0.18 g/fish.
Source: Purchased 12-3-93 from Mt. Lassen Trout Farms, Red Bluff, CA. Hatch date 11-2-93.
Acclimation: Temperature, 12.3 ± 2.3°C; dissolved oxygen, 9.6 ± 1.1 mg/L; pH, 7.7 ± 0.5; and conductivity, 482 ± 121 µmhos/cm for the seventeen days prior to testing. Acclimation tank loading: 0.54 g/L.

TEST PROCEDURES AND CONDITIONS

Test Chambers: one-gal. glass jars containing 3.5 L test solution.
Test Concentrations: 5000, 2500, 1250, 625, 312, and 0 mg/L (control).
Replicates/Treatment: 3
Organisms/Treatment: 30
Loading: 0.51 g/L
Water Volume Changes per 24 hr: None.
Effects Criteria: Mortality, defined as the lack of respiratory movement in response to tactile stimulation.
Water Quality and Other Test Conditions: Temperature, 15.2 ± 0.4°C; dissolved oxygen, 8.6 ± 0.8 mg/L; pH, 7.7 ± 0.3; conductivity, 3450 ± 1022 µmhos/cm (5000 mg/L), 310 ± 14 µmhos/cm (control); hardness, 110 ± 20 mg/L as $CaCO_3$ (5000 mg/L), 98 ± 5 mg/L as $CaCO_3$ (control); and alkalinity, >500 mg/L as $CaCO_3$ (5000 mg/L), 78 ± 5 mg/L as $CaCO_3$ (control). Photoperiod 16:8 hr, L:D.

DATA ANALYSIS METHODS

Percent survival was calculated for each treatment replicate from the raw data and the means were obtained for each treatment level. The LC50 and 95% confidence intervals were calculated using the Trimmed Spearman-Karber method (EPA 600/4-90-027). The statistical software employed for these calculations was ToxCalc, v. 4.0, Tidepool Scientific Software.

PROTOCOL DEVIATIONS

1. Sodium dodecyl sulfate (SDS) was used as the reference toxicant because this was the standard reference toxicant in use by the laboratory for the rainbow trout acute test.

REFERENCE TOXICANT TEST

Test No.: 999-306
Reference Toxicant and Source: Sodium dodecyl sulfate (SDS). Sigma Lot No. 88F-05-631.
Test Date: 12-13-93
Dilution Water Used: NAS spring water.
Result: 96-hr LC50, 12.5 mg/L SDS.
Control Chart: The laboratory has recently been forced to change reference toxicants for this test from linear alkyl sulfonate (LAS) to SDS as a result of the current unavailability of the former. Consequently, the laboratory has only one previous test with SDS with which the present test result with this compound (999-306) can be compared. In this former test the LC50 for SDS was 18.3 mg/L. Although not

directly useful for evaluating this test (999-306), the laboratory's control chart for LAS is included in the raw data of the present test (477-4) to demonstrate the laboratory's recent performance in conducting the rainbow trout acute test.

TEST RESULTS

A detailed tabulation of the test results is given in Table 1. The biological effect given as an LC50 is as shown below.

96-hr LC50 (mg/L) (95% conf. int.)	2171 (1905 - 2474)
Method	Trimmed Spearman-Karber

STUDY APPROVAL

D. D. Caldwell 3/1/94

Study Director Date

Julie R. Finn 3-1-94

Quality Assurance Unit Date

CRYOTECH

Material Compatibility and Storage of Cryotech CF7® Liquid Commercial Deicer

Customers frequently ask if material in their storage, handling, and application equipment is compatible with Cryotech CF7® (potassium acetate based) for application on bridges and roadways. There are technical differences between the potassium acetate deicers from various producers, usually in the formulation of corrosion inhibitors. Therefore, some differences in material compatibility are expected. The following information applies to Cryotech CF7, which is 50% potassium acetate, by weight.

CORROSION INHIBITORS

Cryotech CF7® contains less than 1% proprietary corrosion inhibitors. These inhibitors create a protective barrier on the surface of various metals. Performance of these inhibitors is usually linked to the pH of the fluid. Diluted CF7 biodegrades naturally when exposed to air producing by-products such as unsightly biological growth and superficial staining/corrosion. Therefore, the exterior surfaces of application equipment should be rinsed routinely with warm water after use.

EQUIPMENT CONSIDERATIONS

When selecting equipment to transport, store, and apply potassium acetate for bridges, elevated roadways and FAST (Fixed Anti-icing Spray Technology) systems, the following guidelines should be considered:

- **Pumps:** Stainless steel positive displacement pumps or properly sized centrifugal pumps with mechanical seals are preferred. Avoid pump bodies made of brass, cast aluminum, or cast iron, because some castings are of poor quality and may have reduced service life. Avoid large bore, low head (pressure) "trash" pumps. Avoid pumps with brass, zinc or galvanized wetted parts.

- **Pipes:** Stainless steel, carbon steel, PVC, polyethylene, and rubber are okay. Avoid galvanized metals because potassium acetate will react slowly with zinc giving off hydrogen gas.

- **Transfer Hoses:** Wire reinforced chemical hoses with cross-linked polyethylene lining and an EPDM rubber cover are recommended. They should be rated for the system's pressure and vacuum. Stainless steel cam and groove fittings with locking cam levers and EPDM gaskets are also recommended.

- **Tanks:** Stainless steel, fiberglass or polyethylene are preferred. Carbon and alloy steel tanks may be used if clean and rust free. Tanks must be strong enough to hold CF7 which is heavier than water weighing 10.7 pounds per gallon.

- **Gaskets and Seals:** Butyl rubber, ethylene propylene rubber (EPM, EPDM), isoprene, and natural rubber are preferred. Nitrile (Buna N), hypalon, neoprene rubber are generally acceptable. Avoid butadiene, fluorocarbon rubber, fluorosilicon, polyacrylate, polyurethane, SBR rubber (Buna S) and silicon rubber.

INSTALLATION CONSIDERATIONS

Obtain professional engineering assistance to ensure proper design and installation of tanks and components. Make sure the system has relief valves and low point drains, and that block valves can be opened without operator risk. Avoid dissimilar metals or provide properly engineered insulators to minimize the effect of galvanic corrosion. Potassium acetate has low viscosity and low surface tension. Therefore, high quality joints are needed for a leak-free system. Welded or flanged pipe joints are recommended. But if threaded fittings are used, a high quality pipe sealant is important.

STORAGE CONSIDERATIONS

AVOID PROBLEMS

Do not use potassium acetate deicers with galvanized (zinc-plated) metals.
Do not use potassium acetate on poor quality concrete.
Do not mix potassium acetate deicers with deicers from different manufacturers.

Revised 4/29/08

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CRYOTECH

ADDITIONAL INFORMATION: REACTION BETWEEN POTASSIUM ACETATE BASED DEICERS AND ZINC

This bulletin provides additional information about the reaction between zinc and Cryotech's CF7®, potassium acetate-based liquid deicer.

SUMMARY

A slow reaction may occur when zinc is exposed to a potassium acetate-based deicer. The reaction results from prolonged contact and is not an issue during normal use.

ZINC REACTION

Hot-dipped galvanizing places a coating of zinc on the surface of steel. Brass alloys also contain zinc. Although zinc has excellent properties to resist corrosion from atmospheric conditions, it is a fairly reactive metal. As a result, potassium acetate-based deicers, like CF7, can cause a slow reaction in storage systems containing zinc.With prolonged exposure this reaction may cause hydrogen gas to form and zinc to discolor and dissolve.

STORING CF7

Therefore, CF7 should not be stored or plumbed through systems that use galvanized, zinc, or brass components.

FIELD USE

For a number of reasons there is seldom a reaction between potassium acetate and zinc coatings during application.

- Exposure is limited to short intervals.
- Precipitation causes the deicer to dilute.
- Corrosion reactions occur slowly at cold temperatures when deicers are applied.
- Even at low temperatures CF7 biodegrades within a few days.

Experience at the Zilwaukee Bridge near Saginaw, Michigan, where CF7 has been used for years, supports the conclusion that little to no reaction occurs between CF7 and galvanized materials during deicing operations. The bridge is essentially corrosion-free.

CONCLUSION

Do not use galvanized, zinc, or brass tanks or piping for long-term storage of CF7. The exterior surfaces of application equipment should be routinely washed with warm soapy water.

Revised 4/30/08

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CRYOTECH

3/23/08 - Proper Use of Cryotech CF7 and NAAC

Instructions on how to properly use deicing chemicals when dealing with snow, freezing rain, and ice.

Liquid CF7® (potassium acetate) is generally used as an anti-icer to prevent snow and ice from bonding to the surface. The snow and ice can then be easily removed by broom or plow. Solid NAAC® (sodium acetate) is used as a deicer. It is also applied early in the storm but its purpose is to melt through an existing pack and break ice-to-pavement bonds prior to mechanical removal.

CF7 is more efficient than a solid deicer when applied as an anti-icer because it takes less energy to prevent surface bonding than to break existing bonds. Therefore, early liquid application followed by mechanical removal of snow and ice accumulation provides the best and most efficient method for combating winter storms.

"Early application" means applying just before the event or as precipitation begins to fall. Reconmended CF7 rates range from 0.5-1.5 gallons per thousand square feet (25-75 grams per square meter) depending on weather conditions. It is also important to evenly apply the fluid using low-pressure, large droplet nozzles. Surfaces can then be cleaned mechanically until bonds reform and dilution requires additional applications.

How long will it last? Water from snow or ice melt will dilute the CF7, thereby raising the solution freeze point. Depending upon conditions such as air and surface temperature, type and amount of precipitation, and deicer application rate, at some point the dilute solution will become ineffective and re-application will be necessary. The clearest signs that dilution has occurred are low friction and unsatisfactory snow or ice patches remaining after mechanical removal. Dilution can also be determined by computer monitored roadway sensors.

Solid NAAC is generally applied as a deicer on top of the snow or ice pack, but always early in the storm whenever possible. Pack results from surface bonding of snow and ice and is difficult to remove with liquid deicers. It is common for pack to build on roadways as well as on secondary areas like ramps that may not receive anti-icing treatments.

NAAC is applied on the wet area, ice, or pack. As it combines with moisture, NAAC changes from a solid to a liquid. This exothermic phase change – unique to NAAC – releases heat allowing each pellet to quickly penetrate the pack and break surface bonds. Application rates range from 5-15 pounds per thousand square feet (25-75 grams per square meter). Again, it is important to achieve even application. Because NAAC is produced as spherical pellets it spreads more evenly than flaked products.

In certain conditions, CF7 may be used with NAAC to assist with breaking up a heavy pack. After holes are formed by NAAC, CF7 is applied over the top and thereby has a direct route to the pavement surface. This dual application speeds the deicing process.

CF7 is also recommended as a prewetting agent for NAAC to jump-start its phase change. This prewet also causes the solid to stick to the surface, minimizing product loss from wind or vehicle movements. During freezing rain, NAAC may be helpful when applied with CF7. This dual application extends operations by minimizing dilution of the liquid.

NAAC and CF7 should not be combined during routine anti-icing operations. CF7 is more efficient and the addition of NAAC is generally not helpful. The exception is use in the aforementioned freezing rain condition.

Technical assistance and on-site training are available by calling Cryotech at 800-346-7237.

Revised 3/23/08

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CRYOTECH

Toxicity of Acetate-Based Deicers in Marine (Saltwater) Environments

Toxicity of deicers to marine organisms can be important to know when deicing applications are located where run-off can flow into saltwater environments. Cryotech acetate-based solid and liquid deicers are all considered relatively harmless in this type of receiving water.

CF7 Acute Toxicity Testing Results
Cryotech potassium acetate deicer for use on roads and bridges

48-hr LC50, minnows:	6,300 milligrams per liter (mg/L)
48-hr LC50, mysid:	1,400 mg/L

The US Fish and Wildlife Service Toxicity rating scale defines a chemical as "relatively harmless" when acute toxicity results are above 1000 milligrams per liter.

E36 Acute Toxicity Testing Results
Cryotech potassium acetate runway deicer

48-hr LC50, minnows:	6,300 mg/L
48-hr LC50, mysid:	1,400 mg/L

The US Fish and Wildlife Service Toxicity rating scale defines a chemical as "relatively harmless" when acute toxicity results are above 1000 milligrams per liter.

NAAC Acute Toxicity Testing Results
Cryotech anhydrous sodium acetate deicer for use on roads, bridges, and runways

48-hr LC50, minnows:	>7500 mg/L
48-hr LC50, mysid:	>7500 mg/L

The US Fish and Wildlife Service Toxicity rating scale defines a chemical as "relatively harmless" when acute toxicity results are above 1000 milligrams per liter.

Chronic Toxicity Testing:

It is generally agreed by state agencies that acetate-based deicers are readily biodegradable and dissipate rapidly. The chance of chronic long-term exposure is therefore greatly reduced. Given that and the fact that Cryotech acetate-based deicers are relatively harmless, chronic toxicity testing has not been required.

Notes:

This independent laboratory test data was generated using EPA recognized test protocols and deicer formulations provided by Cryotech.

EPA/600/4-90/027F: Method for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms; EPA/600/4-91/002: Short Term Methods of Estimating Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms and; EPA/600/4-91/003: Short Term Methods of Estimating Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms.

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U.S. Department
of Transportation
**Federal Highway
Administration**

Publication No. FHWA-RD-96-178
March 1997

Impedance Spectroscopy for the Evaluation of Corrosion Inhibitors in Highway Deicers

Research and Development
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101-2296

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-RD-96-178		

4. Title and Subtitle	5. Report Date
IMPEDANCE SPECTROSCOPY FOR THE EVALUATION OF CORROSION INHIBITORS IN HIGHWAY DEICERS	March 1997
	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) Ugo Bertocci	
9. Performing Organization Name and Address Office of Engineering R&D Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296	10. Work Unit No. (TRAIS) 3E4b0142
	11. Contract or Grant No. NAS/NRC RA Project Na 27.01.00.04
	13. Type of Report and Period Covered Final Report February 1992 - July 1994
12. Sponsoring Agency Name and Address Office of Engineering R&D Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296	14. Sponsoring Agency Code

15. Supplementary Notes

This work was performed while the author held a National Research Council/FHWA Research Associateship. The FHWA Research Advisor was John W. Peart. FHWA Contact: Robert A. Kogler

16. Abstract

Electrochemical impedance spectroscopy (EIS) measurements were carried out on steel bars embedded in concrete blocks that were immersed in aqueous solutions of commercial deicing salts, many of which had corrosion inhibitors added. The effectiveness of the inhibitors was assessed by monitoring the evolution of the EIS results for a period of 11 months. EIS was supplemented with open circuit potential and polarization measurements. From the results, a semiquantitative ranking of the commercial deicers tested as to their corrosivity could be derived.

17. Key Words	18. Distribution Statement
electrochemical impedance spectroscopy, corrosivity, corrosion inhibitors, deicers, sodium chloride, calcium magnesium acetate, rebar corrosion	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	82	

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TECHNICAL SUMMARY

IMPEDANCE SPECTROSCOPY FOR THE EVALUATION OF CORROSION INHIBITORS IN HIGHWAY DEICERS

Purpose

The purpose of this work was, on the one side, to see if the addition of corrosion inhibitors to commercial deicing mixtures, which contain mainly chloride salts, can be shown to affect the corrosion behavior of steel in concrete. On the other, it was to evaluate the usefulness of electrochemical impedance spectroscopy (EIS) to obtain information on the corrosion of steel in concrete under fairly realistic conditions.

In order to simulate the conditions which are encountered in the field the measurements were carried out on steel rods embedded in concrete, exposed by immersion to solutions of various inhibitor-containing deicers. The measurements were taken over a period of 11 months, enabling one to have a picture of the progress of the corrosion process and to see whether or not corrosion was accelerating with time.

Materials tested

The six deicers tested (numbered from 1 to 6) were commercial products, so that their exact composition and exact nature of their inhibitors are not known. Two of the deicers were in liquid form, presumably because of the chloride salt is mainly $MgCl_2$, while the others contained mainly NaCl. Another deicer tested was a mixture of magnesium and calcium acetates, generally known as CMA. For comparison, a NaCl solution without inhibitors was also tested.

Experimental procedures

The samples employed in the measurements consisted of concrete cylinders, 5 cm in diameter and 12.7 cm in length, in which four rods of A36 steel, 0.635 cm in diameter and 11.4 cm in length, were embedded in a square pattern. About 2.5 cm of the rods extended outside the upper end of the concrete cast. These samples were immersed in deicer containing solutions routinely on Mondays and taken out on Fridays, in order to ensure access to oxygen during the week-end drying periods. All chloride-containing solutions had a chloride concentration of 0.2 M.

Most of the EIS measurements were performed at the open circuit potential E_{oc}. The frequency range of the EIS measurements was pushed as much as possible toward the low frequencies, routinely to 0.5 mHz. To supplement the information provided by EIS, open circuit potential E_{oc} and polarization measurements were also performed. From the EIS data, the value of the corrosion resistance was obtained by fitting the results to an equivalent electrical circuit. The corrosion rate was then calculated with the aid of the results of the polarization measurements.

Composition of the solutions used in the measurements

#	Main constituents	Form	conc. G/L	Inhibitor	sol. pH
1	NaCl	solid	13	Mg phosphate	7.0
2	$MgCl_2$	liquid	30	citrate	9.3
3	NaCl	solid	13	unknown	6.1
4	NaCl 83% $MgCl_2$ 10%	solid	13	PCI™	6.8
5	$MgCl_2$	liquid	35	PCI™	6.0
6	30% $Ca(Ac)_2$ 70% $Mg(Ac)_2$	solid	100	none	9.7
7	NaCl	solid	12	none	6.8

Conclusions

The tests carried out have shown that EIS can be employed for the long term study of corrosion in reinforced concrete, and can be used for ranking the deicer formulations as to their corrosion effects. Since the tests were carried out not on bare steel electrodes, but on rods embedded in concrete, the time required for obtaining meaningful results is quite long. This report describes about one year of tests, and yet in some cases it appears that a longer exposure would have been desirable in order to obtain more clear cut results. On the other hand, the data collected should be more reliable than tests on bare metal, because they probe the ability of the various inhibitors to penetrate the concrete, as well as the capability to counteract the deleterious effects of chloride salts which have already diffused into the material.

In the conditions employed in this study, a good correlation has been found between open circuit potential E_{oc} and corrosion resistance, and by implication corrosion rate. This correlation has been observed by many workers, and has lead to the suggestion that a simple and inexpensive way to monitor the corrosion conditions of steel in reinforced concrete is that of measuring E_{oc}. However, it should be kept in mind that the correlation is largely of statistical nature, and there is a substantial scatter in the points, which might entail an uncertainty of more than one order of magnitude in corrosion rate for the same value of the potential.

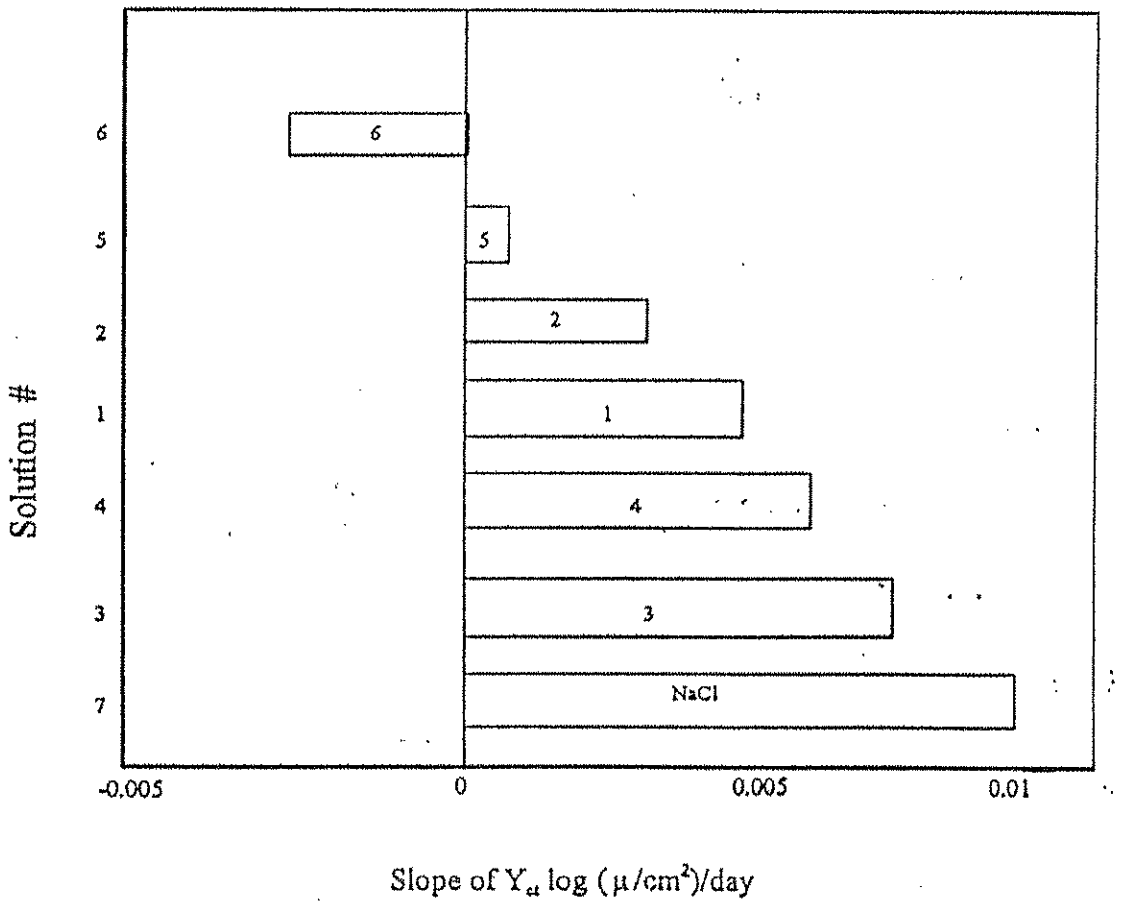
For a ranking of the six deicers, from the least to the most corrosive, one can choose the charge transfer admittance $Y_{ct}=1/R_{ct}$, which is proportional to the corrosion rate, plotting its logarithm versus time and calculating a linear least-squares fit. The higher the slope of the straight line, the greater the corrosion rate becomes, indicating a failure to protect the steel on the part of the inhibitor. The resulting ranking is shown in the following list:

1. Solution #6 CMA
2. Solution #5
3. Solution #2
4. Solution #1 and #4

5. Solution #3 and #7 NaCl

The ranking can be presented graphically also, taking a semiquanitative aspect, as shown in the figure.

One should not, however, attach too much meaning to small differences in the numerical value of the slopes. Therefore it is doubtful that deicers #1 and #4 behave significantly better than plain road salt, #7. CMA (#6) is clearly superior to all others, but deicers #5 and to much more limited extent, deicer #2 have shown to be able to slow down corrosion.



Researcher-This study was performed by Dr. Ugo Bertocci while sponsored by FHWA/NRC under their cooperative Research Associateship program.

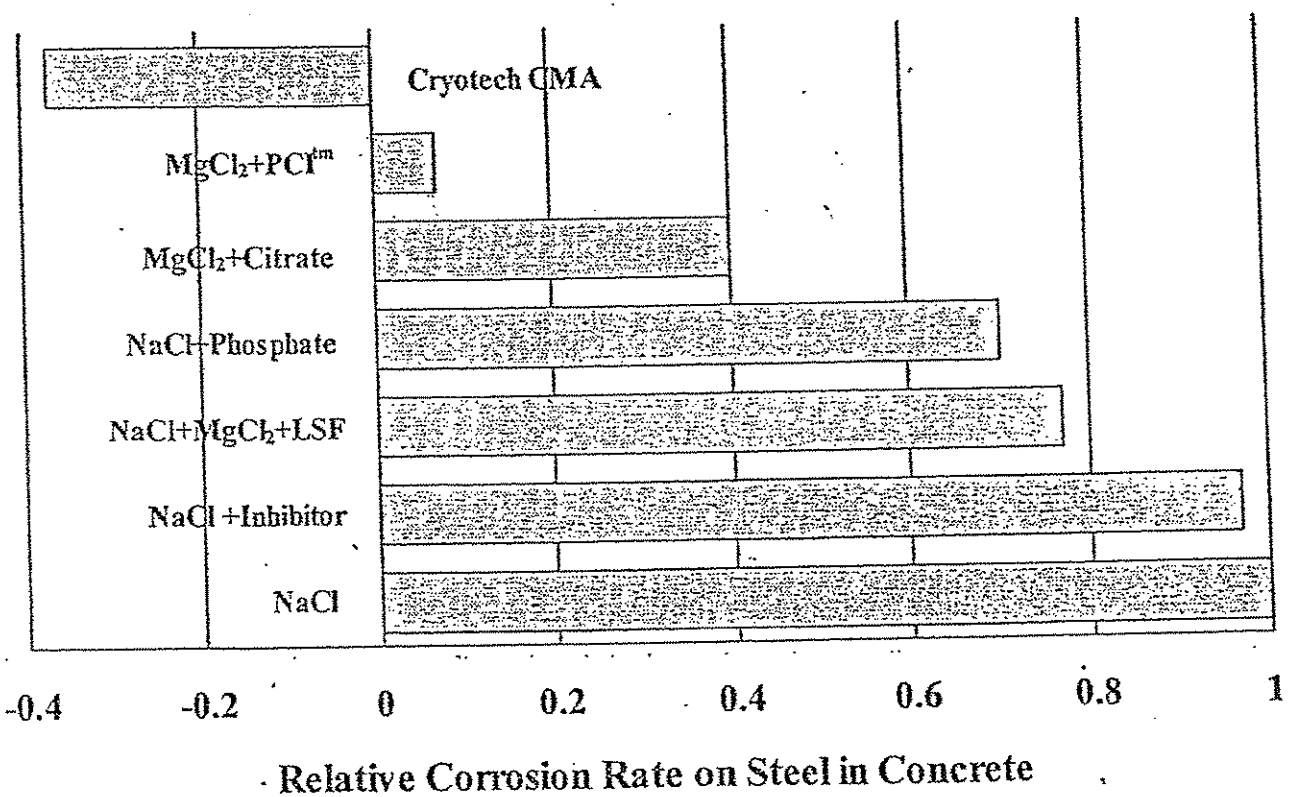
Distribution-This technical summary is being distributed according to a standard distribution. Direct distribution is being made to the Regions and Divisions.

Availability-The publication will be available in . Copies will be available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. A limited number of copies will be available from the R&T Report Center, HRD-11, FHWA, 6300 Georgetown Pike, McLean, Virginia 22101-2296.

Key Words-electrochemical impedance spectroscopy, corrosivity, corrosion, inhibitors, deicers, sodium chloride, calcium magnesium acetate, concrete, rebar corrosion.

Notice-This technical summary is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The summary provides a synopsis of the study's final publication. The summary does not establish policies or regulations, nor does it imply FHWA endorsement of the conclusions or recommendations. The U.S. Government assumes no liability for the contents or their use.

Corrosion Rates of Various Deicers



Publication No. FHWA-RD-96-178, "Impedance Spectroscopy for the Evaluation of Corrosion Inhibitors in Highway Deicers", US Federal Highway Administration, March 1997

~ MEMORANDUM ~

Date: October 1, 2006

To: To Whom It May Concern

From: Cryotech Deicing Technology

Subject: Cryotech CF7® Liquid Deicer

Cryotech Deicing Technology warrants that Cryotech CF7 deicer to be delivered hereunder shall conform to the specifications attached hereto; and upon receipt of payment therefore, shall be free from any security interest or encumbrance. Cryotech **disclaims** all warranties and conditions, either express or implied, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose. In no event shall Cryotech be liable to the Buyer or to any third party for any indirect, incidental, special, consequential, punitive, or exemplary damages (including without limitation lost profits, lost savings, or loss of business opportunity) arising out of or relating to the deicer, or the use or inability to use the same, even if Cryotech has been advised of the possibility of such damages.

CRYOTECH

Date: September 28, 2007

To: To Whom It May Concern

From: Cryotech Deicing Technology

Subject: PNS Approved Products

Non-chloride Calcium Magnesium Acetate (Cryotech CMA®), Potassium Acetate (Cryotech CF7®), and Liquid CMA (A 25% mixture of Cryotech CMA® and potable water) are located on the Pacific Northwest Snowfighters (PNS) Association's approved product list. The transportation agencies of Washington, Oregon, Montana, Idaho, and the province of British Columbia formed PNS several years ago to outline specifications for deicing chemicals.

For more information regarding the PNS Association, please visit: http://www.wsdot.wa.gov/partners/pns/default.htm.

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E-mail: deicers@cryotech.com http://www.cryotech.com

CRYOTECH

CF7 Contacts

Cryotech CF7 liquid commercial deicer, a patented acetate-based formulation, is being used in FAST (Fixed Anti-icing Spray Technology) systems throughout North America. This non-chloride based product will not damage FAST systems nor the bridge decks or its supports.

Why Cryotech CF7 is preferred:

- Is chloride-free for long term bridge life.
- Needs no agitation in storage or in the charged system.
- Is environmentally friendly.
- Enables long term accurate application.
- Is compatible with asphalt concrete pavement materials.
- Works to low temperatures; freeze point is -76°F (-60°C).
- Exhibits a longer residual action; dilutes slower than chloride deicers (see FHWA Manual of Practice on Anti-icing).
- It is a 50% concentrate solution.
- Provides good friction results; not slippery.
- Has a proven history of performance. Used by many state DOT's.
- Is cost effective; includes free initial training session.
- Eligible for Matching Federal Funds – SAFETEA-LU.

Listed below are a few organizations who currently use Cryotech CF7 in FAST systems. These people have given their permission and would welcome your inquiries about our products and service.

1. Ms. Christine Beckwith
   Project Engineer
   Minnesota Department of
   Transportation
   651-582-1431
   Christine.Beckwith@dot.state.mn.us

2. Mr. Brandon Ward
   Bridge Engineer
   City of New York Department of
   Transportation
   212-788-1720
   bward2@dot.nyc.gov

3. Mr. Mike Layman
   Maintenance Contract Inspector
   Maryland Department of
   Transportation
   301-729-8483
   mlayman@fha.state.md.us

4. Mr. Troy Gilbertson
   Highway Maintenance Coordinator
   North Dakota Department of
   Transportation
   701-239-8900
   tgilbert@nd.gov

5. Mr. Sam Sherman
   Research Engineer
   Utah Department of
   Transportation
   801-965-4438
   ssherman@utah.gov

6. Mr. Michael Metiva
   Superintendent
   Michigan Department of
   Transportation
   989-754-0916 Ext. 32
   metivam@michigan.gov

Please feel free to visit our website at www.cryotech.com for more information.

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com

Revised 3/08

CRYOTECH

MEMORANDUM

TO: CF7 AND E36 LAVATORY ANTIFREEZE CUSTOMERS

FROM: CRYOTECH DEICING TECHNOLOGY

SUBJECT: CF7, E36 LAVATORY ANTIFREEZE, AND E36 LIQUID DEICING CHEMICALS

DATE: 7/18/07

CC: FILE

Cryotech CF7® and Cryotech E36 Lavatory Antifreeze are materially the same chemistry as Cryotech E36® – 50% potassium acetate solution plus a proprietary inhibitor package. CF7 is sold to commercial and government markets for use on roads, bridges, parking garages, sidewalks, etc., E36 Lavatory Antifreeze is sold for use in aircraft lavatory systems, and E36 is sold to airports and military bases for use on runways and ramps.

E36 is certified to AMS 1435 for runway use; CF7 is not. Any test data that references E36 is also applicable to CF7 and E36 Lavatory Antifreeze. However, because they are used for different applications, usage rates, labels, product data, and training information are different for each product. For further information or questions, please contact Cryotech at 800-346-7237 or 319-372-6012.

6103 Orthoway, Fort Madison, IA 52627 Tel: +1 (319) 372-6012 +1 (800) 346-7237 Fax: +1 (319) 372-2662
E-mail: deicers@cryotech.com http://www.cryotech.com

CRYOTECH

Guidance on Safe, Accountable, Flexible, Efficient Transportation Act: A Legacy for Users

Non-chloride based Calcium Magnesium Acetate (Cryotech CMA®), Sodium Acetate (Cryotech NAAC®), and Potassium Acetate (Cryotech CF7®) are eligible for matching Federal Funds under the SAFETEA-LU act that was passed in August 2005. Through the SAFETEA-LU act, funds are available for low corrosive anti-icing/deicing applications and environmentally preferred anti-icers/deicers used on highway bridges through 2009. This act is building on the foundation provided by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century of 1998 (TEA-21), which originated to help preserve and rehabilitate America's bridges. There is approximately $21.6 billion authorized through 2009 for the Highway Bridge Program section of the act.

TITLE I—FEDERAL-AID HIGHWAYS

Subtitle A—Authorization of Programs

SEC. 1114. HIGHWAY BRIDGE PROGRAM.

(a) FINDING AND DECLARATION.—Section 144(a) of title 23, United States Code, is amended to read as follows:

"(a) FINDING AND DECLARATION.—Congress finds and declares that it is in the vital interest of the United States that a highway bridge program be carried out to enable States to improve the condition of their highway bridges over waterways, other topographical barriers, other highways, and railroads through replacement and rehabilitation of bridges that the States and the Secretary determine are structurally deficient or functionally obsolete and through systematic preventive maintenance of bridges.".

(b) PARTICIPATION.—Section 144(d) of such title is amended to read as follows:

"(d) PARTICIPATION.—

H. R. 3—30

"(1) BRIDGE REPLACEMENT AND REHABILITATION.—On application by a State or States to the Secretary for assistance for a highway bridge that has been determined to be eligible for replacement or rehabilitation under subsection (b) or (c), the Secretary may approve Federal participation in—

"(A) replacing the bridge with a comparable facility; or

"(B) rehabilitating the bridge.

"(2) TYPES OF ASSISTANCE.—On application by a State or States to the Secretary, the Secretary may approve Federal assistance for any of the following activities for a highway bridge that has been determined to be eligible for replacement or rehabilitation under subsection (b) or (c):

"(A) Painting.

"(B) Seismic retrofit.

"(C) Systematic preventive maintenance.

"(D) Installation of scour countermeasures.

"(E) Application of calcium magnesium acetate, sodium acetate/formate, or other environmentally acceptable, minimally corrosive anti-icing and de-icing compositions.

"(3) BASIS FOR DETERMINATION.—The Secretary shall determine the eligibility of highway bridges for replacement or rehabilitation for each State based on structurally deficient and functionally obsolete highway bridges in the State.

"(4) SPECIAL RULE FOR PREVENTIVE MAINTENANCE.—Notwithstanding

any other provision of this subsection, a State may carry out a project under paragraph (2)(B), (2)(C), or (2)(D) for a highway bridge without regard to whether the bridge is eligible for replacement or rehabilitation under this section.".

(c) APPORTIONMENT OF FUNDS.—Section 144(e) of such title is amended—

(1) in the third sentence by striking "square footage" and inserting "deck area";

(2) in the fourth sentence by striking "the total cost of deficient bridges in a State and in all States shall be reduced by the total cost of any highway bridges constructed under subsection (m) in such State, relating to replacement of destroyed bridges and ferryboat services, and,"; and

(3) in the seventh sentence by striking "for the same period as funds apportioned for projects on the Federal-aid primary system under this title" and inserting "for the period specified in section 118(b)(2)".

(d) OFF-SYSTEM BRIDGES.—Section 144(g)(3) of such title is amended to read as follows:

"(3) OFF-SYSTEM BRIDGES.—

"(A) IN GENERAL.—Not less than 15 percent of the amount apportioned to each State in each of fiscal years 2005 through 2009 shall be expended for projects to replace, rehabilitate, paint, perform systematic preventive maintenance or seismic retrofit of, or apply calcium magnesium acetate, sodium acetate/formate, or other environmentally acceptable, minimally corrosive anti-icing and de-icing compositions to, or install scour countermeasures to, highway bridges located on public roads, other than those on a

Federal-aid highway, or to complete the Warwick Intermodal Station (including the construction of a people mover between the Station and the T.F. Green Airport).

"(B) REDUCTION OF EXPENDITURES.—The Secretary, after consultation with State and local officials, may reduce the requirement for expenditure for bridges not on a Federal-aid highway under subparagraph (A) with respect to the State if the Secretary determines that the State has inadequate needs to justify the expenditure.".

(e) BRIDGE SET-ASIDE.—

(1) FISCAL YEAR 2005.—Section 144(g)(1)(C) of such title is amended—

(A) in the subsection heading by striking "2003" and inserting "2005"; and

(B) in the first sentence by striking "2003" and inserting "2005".

(2) FISCAL YEARS 2006 THROUGH 2009.—Effective October 1, 2005, section 144(g) of such title (as amended by subsection (d) of this section) is amended—

(A) by striking the subsection designation and all that follows through the period at the end of paragraph (2) and inserting the following:

"(g) BRIDGE SET-ASIDES.—

"(1) DESIGNATED PROJECTS.—

"(A) IN GENERAL.—Of the amounts authorized to be appropriated to carry out the bridge program under this section for each of the fiscal years 2006 through 2009, all but $100,000,000 shall be apportioned as provided in subsection (e). Such $100,000,000 shall be available as follows:

"(i) $12,500,000 per fiscal year for the Golden Gate Bridge.

"(ii) $18,750,000 per fiscal year for the construction of a bridge joining the Island of Gravina to the community of Ketchikan in Alaska.

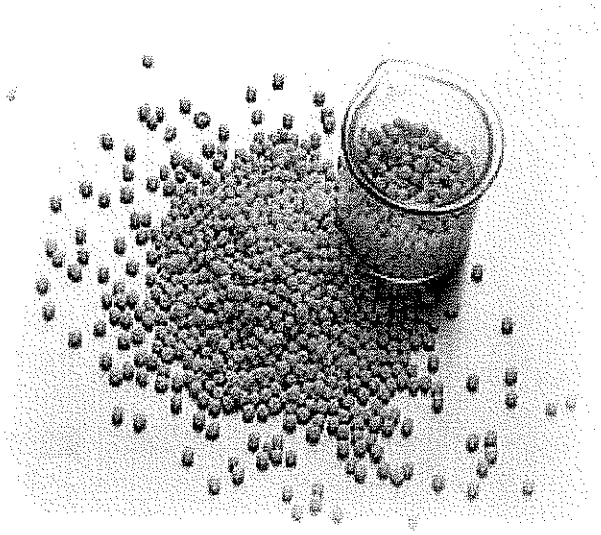
"(iii) $12,500,000 per fiscal year to the State of Nevada for construction of a replacement of the federally owned bridge over the Hoover Dam in the Lake Mead National Recreation Area.

"(iv) $12,500,000 per fiscal year to the State of

Missouri for construction of a structure over the Mississippi River to connect the City of St. Louis, Missouri, to the State of Illinois.
"(v) $12,500,000 per fiscal year for replacement and reconstruction of State maintained bridges in the State of Oklahoma.
"(vi) $4,500,000 per fiscal year for replacement of the Missisquoi Bay Bridge, Vermont.
"(vii) $8,000,000 per fiscal year for replacement and reconstruction of State-maintained bridges in the State of Vermont.
"(viii) $8,750,000 per fiscal year for design, planning, and right-of-way acquisition for the Interstate Route 74 bridge from Bettendorf, Iowa, to Moline, Illinois.
H. R. 3—32
"(ix) $10,000,000 per fiscal year for replacement and reconstruction of State-maintained bridges in the State of Oregon.
"(B) GRAVINA ACCESS SCORING.—The project described in subparagraph (A)(ii) shall not be counted for purposes of the reduction set forth in the fourth sentence of subsection (e).
"(C) PERIOD OF AVAILABILITY.—Amounts made available to a State under this paragraph shall remain available until expended.";
(B) by striking paragraph (2); and
(C) by redesignating paragraph (3) as paragraph (2).
(f) CONTINUATION OF REPORT; FEDERAL SHARE.—Section 144 of such title is amended by adding at the end the following:
"(r) ANNUAL MATERIALS REPORT ON NEW BRIDGE CONSTRUCTION AND BRIDGE REHABILITATION.—Not later than 1 year after the date of enactment of this subsection, and annually thereafter, the Secretary shall publish in the Federal Register a report describing construction materials used in new Federal-aid bridge construction and bridge rehabilitation projects.
"(s) FEDERAL SHARE.—
"(1) IN GENERAL.—Except as provided under paragraph (2), the Federal share of the cost of a project payable from funds made available to carry out this section shall be determined under section 120(b).
"(2) INTERSTATE SYSTEM.—The Federal share of the cost of a project on the Interstate System payable from funds made available to carry out this section shall be determined under section 120(a).".
(g) TECHNICAL AMENDMENT.—Section 144(i) of such title is amended by striking "at the same time" and all that follows through "Congress".

United States Congress 109th Congress, 1st Session. Public Law 109-59 SAFE, ACCOUNTABLE, FLEXIBLE, EFFICIENT TRANSPORTATION EQUITY ACT: A LEGACY FOR USERS 109th Congress. Congressional Bills, GPO Access. http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_public_laws&docid=f:publ059.109

CRYOTECH



Replace the Deicer, Not the Structure

Spec: Cryotech CMA®

SOLID COMMERCIAL DEICER

BENEFITS
- Low corrosion: less corrosive than tap water
- Safe for concrete: the safest deicer for concrete, even new concrete cured at least 28 days
- Excellent inhibitor: reduces chloride corrosion
- Safe for the environment: readily biodegradable, low toxicity
- Residual effect: requires fewer applications than other common deicers
- Multi-purpose: use straight, with salt, with sand, or as a liquid

PERFORMANCE
- Works best above 20°F (-7°C)
- Has long lasting effect - better than salt or urea
- Breaks/inhibits bond between snow/ice and pavement
- Creates a dry, powdery snow which improves traction

APPLICATION
- Apply early in the storm to prevent snow/ice bonding
- First application:
  - Commercial = 15-20 lbs/1000ft^2 (75-100 g/m^2)
  - Highway = 300-400 lbs/lane mile (20-40 g/m^2)
- Wait at least 20 minutes to remove snow/ice
- Re-apply when new snow/ice accumulation shows first tendency to bond

ENVIRONMENT
- Biodegrades to carbon dioxide and water
- Calcium and magnesium increase soil permeability
- Essentially non-toxic to aquatic species
- Poor mobility in soil - unlikely to reach groundwater
- Safe for vegetation
- Does not contain nitrogen or chlorides

HANDLING
- May be stored indefinitely if kept dry
- Take care to avoid caking caused by excess moisture
- Excessive handling may cause dustiness

ISO 9001 FM 39092

ISO 14001 EMS 89384

See Reverse Side For Product Specifications

Complete Technical Brochure Available Upon Request

AN ISO 9001:2008 & 14001:2004 CERTIFIED COMPANY

PRODUCT SPECIFICATIONS - CRYOTECH CMA®

COMPOSITION

Calcium Magnesium Acetate (CMA)
3:7 Ca to Mg molar ratio

Hydrated CMA + other acetates	96% minimum
Inert Material	4% maximum

PARTICLE SIZE

Sieve	% Passing
4	90
14	10

SHAPE Hard spherical pellet

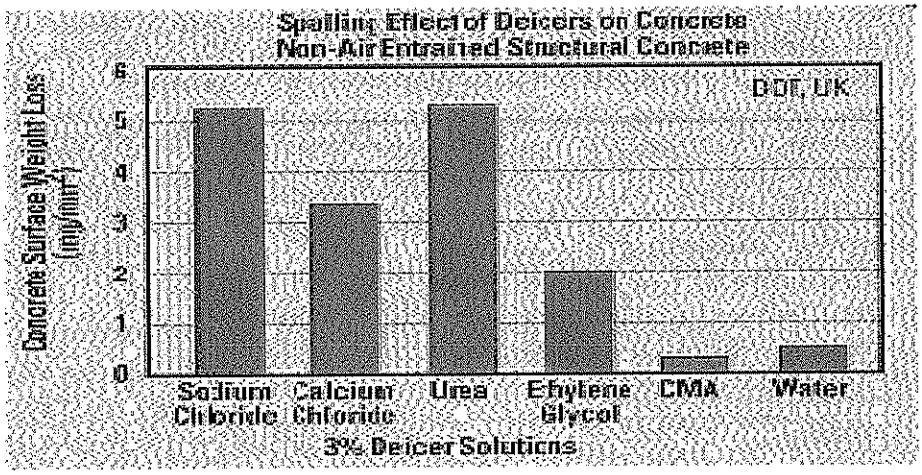
BULK DENSITY 40 lbs/ft^3 to 44 lbs/ft^3
(0.65 g/cm^3 to 0.79 g/cm^3)

TYPICAL pH 8 to 10 in a 10% solution

RESIDUAL BASE Maximum 0.4 meg base/gm

PACKAGING
25 kg (55 lbs) poly bags - (40 bags minimum)
1000 kg (2205 lbs) Super Sacks - (1 SS minimum)
Bulk - (20 metric ton minimum)

Spalling Effect of Deicers on Concrete



Revised - 06/09

TO ORDER OR FOR PRODUCT INFORMATION CONTACT:
Ph: +1 319.372.6012 or +1 800.346.7237 Fax: +1 319.372.2662 E-mail: deicers@cryotech.com

Cryotech Deicing Technology . 6103 Orthoway . Fort Madison, IA . 52627 . WWW.CRYOTECH.COM

CRYOTECH CMA®
MATERIAL SAFETY DATA SHEET

1. PRODUCT NAME & DESCRIPTION

Cryotech CMA® Deicer

MANUFACTURED AND SUPPLIED IN THE USA BY
Cryotech Deicing Technology
6103 Orthoway
Fort Madison, IA 52627
United States

Cryotech Contact Information
Telephone: (800)346-7237
FAX: (319)372-2662
email: deicers@cryotech.com
website: http://www.cryotech.com

2. CHEMICAL COMPOSITION

The percent compositions are given to allow for the various ranges of the components present in the whole product and may not equal 100%.

Percent	Component	CAS#
100%	Cryotech CMA® Deicer	
Containing		
96%	Hydrated Calcium Magnesium and other acetates	76123-46-1
<4.0%	Water-insoluble material	

CAS - Chemical Abstract Service Number

3. HAZARD IDENTIFICATION

(also see Sections 11 and 12)

CAUTION! - MAY CAUSE EYE IRRITATION

EYE CONTACT:
This substance is not expected to cause prolonged or significant eye irritation
SKIN IRRITATION:
This substance is not expected to cause prolonged or significant skin irritation
DERMAL TOXICITY:
If absorbed through the skin, this substance is considered practically non-toxic to internal organs.
RESPIRATORY/INHALATION:
If inhaled, this substance is considered practically non-toxic to internal organs.
INGESTION:
If swallowed, this substance is considered practically non-toxic to internal organs.
OCCUPATIONAL EXPOSURE LIMITS:
None established per OSHA, PEL and ACGIHTLV (TWA)

4. FIRST AID MEASURES

Chemical Emergency: Spill, leak, fire, or accident call
Chemtrec day or night (800)424-9300;
Outside continental USA call (703)527-3887

EYE CONTACT:
No first aid procedures are required. However, as a precaution flush eyes with fresh water for 15 minutes. Remove contact lenses if worn.
SKIN CONTACT:
No first aid procedures are required. As a precaution, wash skin thoroughly with soap and water. Remove and wash contaminated clothing.
INHALATION: Since this material is not expected to be an immediate inhalation problem, no first aid procedures are required.
INGESTION:
If swallowed, give water or milk to drink and telephone for medical advice. Consult medical personnel before inducing vomiting. If medical advice cannot be obtained, then take the person and product container to the nearest medical emergency treatment center or hospital.

5. FIRE FIGHTING MEASURES

FLASH POINT: Not applicable
AUTO IGNITION: No data
FLAMMABILITY LIMITS (% by volume in air):
Lower: No data Upper: No data
EXTINGUISHING MEDIA:
Material does not burn.
FIRE FIGHTING PROCEDURES:
This material will not burn.
COMBUSTION PRODUCTS:
None
NFPA RATINGS:
Health 0; Flammability 0; Reactivity 0; Special NDA:
HMIS RATINGS:
Health 0; Flammability 0; Reactivity 0; Special NDA:
(Least - 0, Slight - 1, Moderate - 2, High - 3, Extreme - 4)
These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint Coating Association.

6. ACCIDENTAL RELEASE MEASURES

Chemical Emergency: Spill, leak, fire, or accident call
Outside continental USA call (703)527-3887
Chemtrec day or night (800)424-9300;

Sweep up spills and transfer to a container for disposal. See section 13.
If needed, wash spillage area with plenty of water.

7. HANDLING AND STORAGE

Avoid contact with skin and eyes.
Do not store or handle product with systems constructed of parts that have galvanized steel, zinc or brass components.

CRYOTECH CMA®
MATERIAL SAFETY DATA SHEET

8. EXPOSURE CONTROLS/PERSONAL PROTECTION
EYE PROTECTION:
No special eye protection is usually necessary.
SKIN PROTECTION:
No special skin protection is usually necessary.
RESPIRATORY PROTECTION:
No special respiratory protection is normally required. However, if operating conditions create high airborne concentrations, the use of an approved respirator is recommended.
VENTILATION: No special ventilation is necessary. However, if operating conditions create high airborne concentrations of this material, special ventilation may be needed.

9. PHYSICAL AND CHEMICAL PROPERTIES
SOLUBILITY: Partially soluble in water.
Appearance: White to off-white spherical granule
BOILING POINT: No Data
MELTING POINT: No Data
EVAPORATION: No Data
SPECIFIC GRAVITY: 1.2 min
VAPOR PRESSURE: No data
PERCENT VOLATILE (VOLUME %): No data
VAPOR DENSITY (AIR = 1): No data
pH: 8-10 (10% aqueous solution)

10. STABILITY & REACTIVITY
HAZARDOUS DECOMPOSITION PRODUCTS:
Not applicable
STABILITY:
Stable.
HAZARDOUS POLYMERIZATION:
Polymerization will not occur.
INCOMPATIBILITY:
None
SPECIAL PRECAUTIONS:
READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL.

11. TOXICOLOGICAL INFORMATION
EYE IRRITATION:
The Draize Eye Irritation Score (range, 0-110) in rabbits is 8.7
SKIN IRRITATION:
The Draize Skin Primary Irritation Score (range, 0-8) for a 4-hour exposure (rabbits) is 0.1. This material was not a skin sensitizer in the Buehler Guinea Pig Sensitization Test.
DERMAL TOXICITY:
The dermal LD50 in rabbits is >5.0 g/kg
RESPIRATORY/INHALATION:
The 4-hour inhalation LC50 in rats is 4.6 mg/liter
INGESTION:
The oral LD50 in rats is greater than 5000 mg/liter. Additional Toxicological Data: The 96-hour LC50 in rainbow trout (Salmo gairdneri) is >1000 mg/L The 48-hour LC50 daphinia (Daphnia magna) is >1000 mg/L.
Results of a 28-day oral toxicity study in rats showed that daily doses of 1000 mg/kg of Cryotech CMA Deicer caused no significant toxicity.

12. ECOLOGICAL INFORMATION
COD (TOD):	0.75 kg O_2/kg
BOD_{20} @ 2° C:	0.40 kg O_2/kg
BOD_{20} @ 10° C:	0.67 kg O_2/kg

13. DISPOSAL CONSIDERATION
Based on information available to Cryotech Deicing Technology, this product is neither listed as a hazardous waste nor does it exhibit any of the characteristics that would cause it to be classified or disposed of as an RCRA hazardous waste. If product should spill or be otherwise unsuitable for normal deicing applications, it may be absorbed on suitable materials and disposed of in sanitary landfill unless state or local regulations prohibit such disposal.

14. TRANSPORT INFORMATION
Not restricted under any transport regulations.

15. REGULATORY INFORMATION
DOT SHIPPING NAME: Not designated as a hazardous material by the Federal DOT.
DOT HAZARD CLASS: Not Applicable
DOT IDENTIFICATION NUMBER: Not Applicable
SARA 311 CATEGORIES:

1. Immediate (Acute) Health Effects:	Yes
2. Delayed (Chronic) Health Effects:	No
3. Fire Hazard:	No
4. Sudden Release of Pressure Hazard:	No
5. Reactivity Hazard:	No

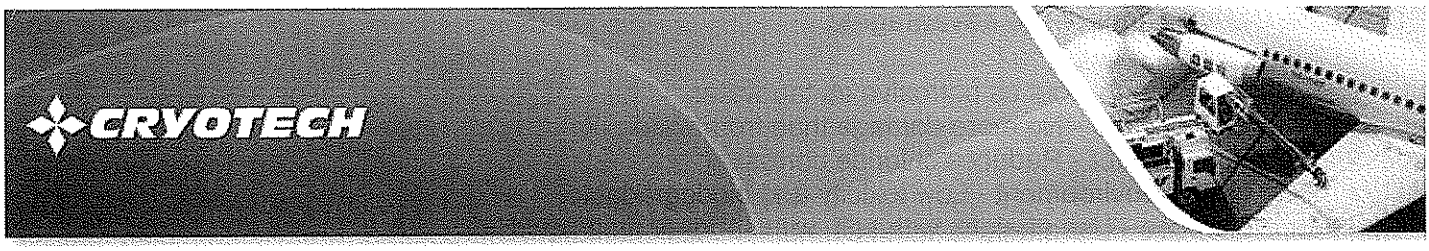
REGULATORY LISTS SEARCHED:

01 = SARA 313	02 = MASS RTK
03 = NTP Carcinogen	04 = CA Prop. 65
05 = MI 406	06 = IARC Group 1
07 = IARC Group 2A	08 = IARC Group 2B
09 = SARA 302/304	10 = PA RTK
11 = NJ RTK	12 = CERCLA 302.4
13 = MN RTK	14 = ACGIH TLV
15 = ACGIH STEL	16 = ACGIH Calculated TLV
17 = OSHATWA	18 = OSHA STEL
20 = EPA Carcinogen	21 = TSCA Sect 4(e)
22 = TSCA Sect 5(a)(e)(f)	23 = TSCA Sect 6
24 = TSCA Sect 12(b)	25 = TSCA Sect 8(a)
26 = TSCA Sect 8(d)	28 = Canadian WHMIS
29 = OSHA CEILING	

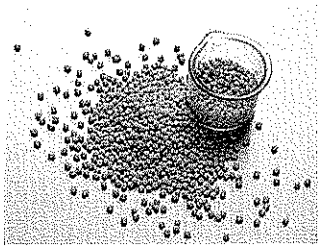
None of the components of this material are found on the regulatory lists indicated.

16. OTHER INFORMATION
ADDITIONAL HEALTH DATA COMMENT:
Effects of overexposure: High concentration of dust may cause irritation of eyes, nose and throat, especially for people with chronic respiratory problems This Material Safety Data Sheet contains environmental, health and toxicology information for your employees. Please make sure this information is given to them. It also contains information to help you meet community right-to-know/emergency response reporting requirements under SARA Title III and many other laws. If you resell this product, this MSDS must be given to the buyer or the information incorporated in your MSDS. Discard any previous edition of this MSDS. **Latest version of this MSDS can be found at http://www.cryotech.com**

The above information is accurate to the best of our knowledge. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use or misuse are beyond our control, **Cryotech Deicing Technology, a Division of General Atomics International Services Corporation makes no warranty, either express or implied, with respect to the completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon.** Cryotech Deicing Technology, a Division of General Atomics International Services Corporation assumes no responsibility for any injury or loss resulting from the use of the product described herein. User should satisfy himself that he has all current data relevant to his particular use.



Cryotech CMA® Calcium Magnesium Acetate



Cryotech CMA® is granulated calcium magnesium acetate, a patented chemical formulation from dolomitic lime and acetic acid. It was first identified as a low corrosion, environmental alternative to road salt by the U.S. Federal Highway Administration in the late 1970's. Cryotech, and its predecessor Chevron, then tested and commercially developed the technology. Today, CMA is used worldwide to answer environmental concerns and solve problems associated with corrosion and concrete spalling.

CMA is generally used in a solid form and spread on the surface like other deicers. Although CMA is effective to the same temperatures as salt, CMA has many unique performance characteristics. Therefore, first-time users should review product application guidelines closely. For answers to frequently asked questions regarding CMA, please see the Questions and Answers information sheet.

Often CMA is used as a corrosion inhibitor, blended with road salt at rates greater than 20% CMA by weight. It is available from Cryotech in a 40% blend as CMA40®.

CMA is also used in liquid form, generally for anti-icing roads and bridges. Here, the fluid is applied prior to a storm event to prevent snow and ice from bonding to the surface. Liquid CMA is typically formulated in the field from dry CMA. Contact Cryotech for mixing instructions.

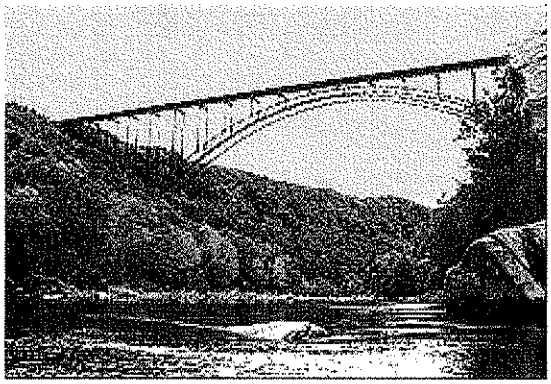
Please see the CMA Fact Sheet for a brief summary of CMA's benefits, application information, and product specifications.

Cryotech CMA® offers these advantages:

- Low Corrosion - About as corrosive as tap water
- Safe for Concrete - No more damage than from water
- Excellent Inhibitor - Reduces chloride corrosion
- Safe for the Environment - Low toxicity and biodegradable
- Multi-Purpose - Use straight, with salt, with sand, or as a liquid

Customer Profile

Typical CMA customers are concerned with concrete spalling, corrosion or environmental issues. They include transportation agencies, military installations, universities, property management firms, and commercial facilities. They require the performance of a solid deicer without the risk of negative environmental impact or infrastructure damage generally associated with chlorides and urea. For these reasons, CMA is often specified by design engineers for use on bridge decks, parking garages and sidewalks, and by operation managers to solve environmental problems such as ground water contamination, soil compaction and vegetation burn.



Product Specifications

COMPOSITION:

Calcium Magnesium Acetate (CMA) (3:7 Ca to Mg molar ratio)
Hydrated CMA + other acetates 96% minimum
Inert Material 4% maximum

Paricle Size:

Sieve	% Passing
4	90
14	10

SHAPE: Hard, spherical pellet

BULK DENSITY: 40 lb/ft3 to 44 lb/ft3 (0.65 g/cm3 to 0.79 g/cm3)

RESIDUAL BASE: Maximum 0.4 meg base/gm pH 8 to 10 in a 10% solution

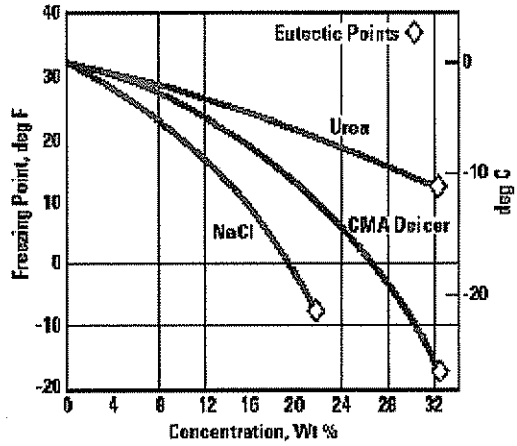
pH: 8 to 10 in a 10% solution

PACKAGING: 25 kg (55 lb.) poly bags; 1000 kg (1 metric ton - 2205 lbs.) Super Sacks, bulk
Minimum orders: 40 - 25 kg bags, 1 Super Sack, 21 metric tons (46,305 lbs.) bulk

See product MSDS for more information.

Product Performance

CMA has been used successfully since 1986 by snow fighters worldwide. It is effective over a similar temperature range as road salt: performance decreases below 20 degrees F (-7 degrees C). Effectiveness is generally enhanced by traffic, sunlight, and warmer temperatures. Because CMA is acetate-based instead of chloride-based, it has unique performance characteristics. Over the years many techniques have been tested and adopted to increase its efficiency.

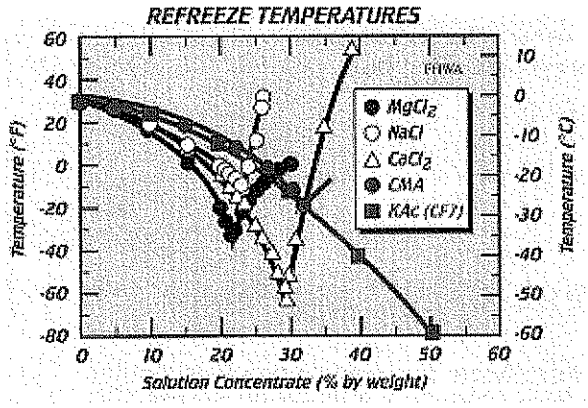


The refreeze temperatures and performance of CMA and KAc (Cryotech CF7®), are addressed in the following excerpt from the **Federal Highway Administration's Manual of Practice for an Effective Anti-icing Program: A Guide for Highway Winter Maintenance Personnel**.

B.4 CMA and KAc (CF7)

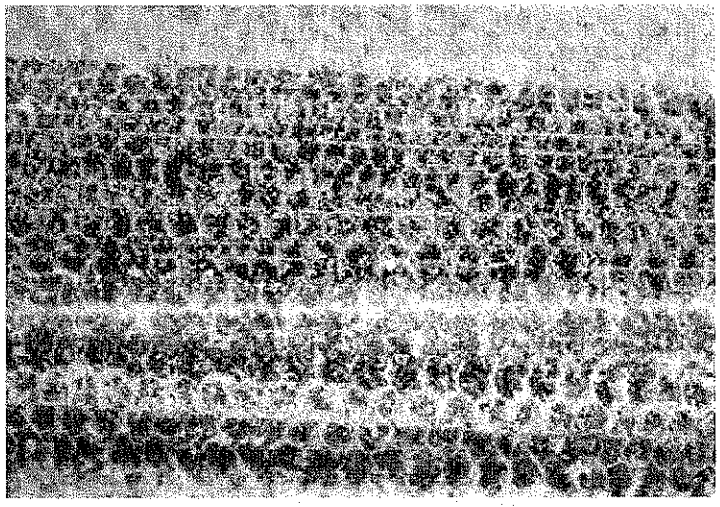
The curve for CMA (Figure 17) was determined from different percent concentration solutions made by dissolving commercially available CMA supplied in a dry pellet form. The curve for KAc (CF7) was determined using a commercially available liquid form of KAc (CF7). The eutectic temperature for the CMA water system in Figure 17 is -27.5°C (-17.5°F) at a concentration of 32.5 percent. The eutectic for the KAc (CF7) - water system is -60°C (-76°F) at a concentration of 49 percent. The curves for the CMA and KAc (CF7) almost coincide with each other. Also, they have a much flatter slope than the other three curves. This is an important feature of both CMA and KAc (CF7) solutions. The refreeze temperature of CMA and KAc (CF7) solutions rises slower with dilution than do the refreeze temperatures of either NaCl, CaCl2, or MgCl2. This feature makes them well suited for being used in a liquid form during anti-icing treatments. This is especially true for their use in a liquid form for the pretreatment of bridge decks in anticipation of frosting, or localized icing conditions.

Figure 17



CMA Works Differently

When mixed with snow, CMA interferes with the ability of snow particles to adhere to each other or to the surface. It does not create a flowing brine like salt, but keeps the snow lighter and drier improving traction. Applied early in the storm, CMA prevents the formation of snow pack and the bonding of ice to the pavement surface, so snow and ice can be removed more easily by plow, broom or shovel.



CMA treated snow appears drier

CMA Has Residual Action

Because CMA does not produce a running brine, it does not move off the surface like other deicers. Therefore, fewer applications are needed during a storm and from storm to storm. Experience has shown that surfaces treated with CMA often exhibit anti-icing properties during subsequent periods of freezing moisture.

CMA Is Applied "Bottom Up"

Early application is the key to effective performance of all deicers, including CMA. At the beginning of a snow event, a heavier application of CMA may be appropriate depending on local conditions. Snow plows and the action of traffic will remove the snow - leaving a residual layer of CMA. Application rates may be decreased as the storm continues.

Environment and Toxicology

CMA research conducted in a variety of academic and private laboratories indicates that negative environmental and toxicological impacts are highly unlikely from its use as a deicer. Of the information collected it can be said that:

1. Concentrations used to deice roads have little to no toxic effects on grass, trees or roadside vegetation;
2. Has little to no toxic effects on aquatic species, including vertebrates and invertebrates;
3. Does not mobilize pre-existing heavy metals;
4. Does not increase algae, periphyton or phytoplankton biomass;
5. Is unlikely to cause problems in treatment plants receiving CMA in storm water runoff;
6. Is unlikely to have significant negative impacts on dissolved oxygen in receiving water;
7. Has low acute mammalian toxicity with effects similar or less severe than those of sodium chloride.

BIODEGRADABILITY

The chemical oxygen demand (COD) of CMA was determined using EPA Method 410.1:

COD = 0.75 g O2/g

The biological oxygen demand (BOD) of CMA was determined using EPA approved dilution methods (Hach). The 20-day incubation BOD value at 10°C is reasonably similar to the COD value suggesting that biological oxidation progresses to the endpoint in 20 days.

BOD20 @ 2°C = 0.40
BOD20 @ 10°C = 0.67

AQUATIC TOXICITY

EPA method 600/4-85-013 was used for measuring the acute toxicity of CMA to freshwater and marine organisms. No mortality was observed at any test level. Based on these study results CMA can be considered to be relatively harmless under generally recognized criteria for accessing acute aquatic toxicity.

Species	Exposure	LC50
Daphnia	48 hours	>1000 mg/L
Rainbow Trout	96 hours	>1000 mg/L

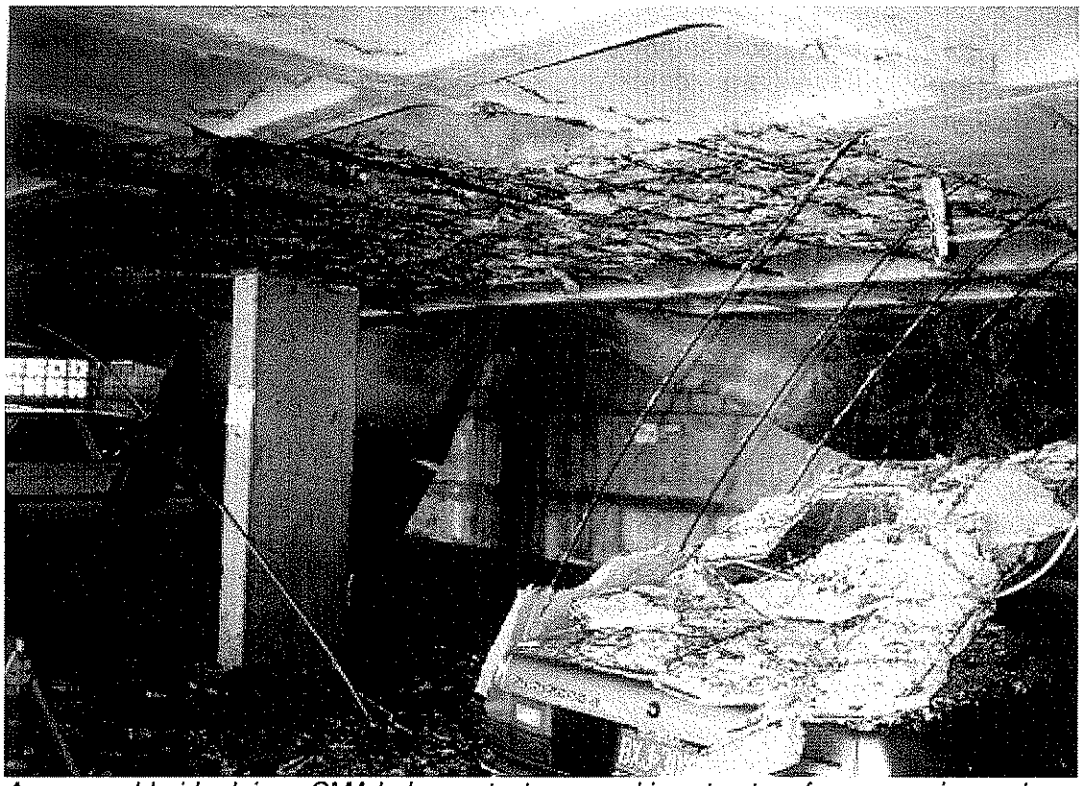
Environmental Impact CMA Versus Road Salt		
Environmental Impact	**CMA**	**Salt (NaCl)**
Soils	Biodegradable in soil. No adverse effect on soil compaction and strength. Increases soil permeability	Sodium may accumulate in soil Breaks down soil structure, increases erosion. Causes soil compaction which decreases permeability.
Vegetation	Little or no adverse effect. May stimulate roadside plant growth. Acetate ion is the most abundant organic acid metabolite found in nature.	Osmotic stress and soil compaction harm root systems. Spray causes foilage dehydration damage. Many plant species are salt sensitive.
Groundwater	Poor mobility in soil, unlikely to reach groundwater. Ca, Mg increases water hardness.	Mobile Na and Cl ions readily reach groundwater. Increases Na and Cl concentrations in well water along with alkalinity and hardness.
Surface Water	Potential for oxygen depletion through biological oxygen demand(BOD) at concentration greater than 100 ppm in closed systems. Decomposes in 5 days at 20°C, 10 days at 10°C, 100 days at 2°C. Will not stimulate algae growth.	Causes density stratification in ponds and lakes which can prevent reoxygenation. Increases runoff of heavy metals and nutrients through increased erosion.
Aquatic Life	Less toxic to trout than salt. Minimal effect on trout eggs up to 5 times expected maximum runoff concentration of 1000 ppm. No effect on food chain (zooplankton, daphnia, bluegill, and fathead minnows) up to up to 1000 ppm.	Monovalent Na, Cl ions stress osmotic balance. Toxic levels: Na 500 ppm stickleback, Cl 400 ppm trout.
Human/Mammalian	Mild skin and eye irritant. Vinegar odor. Acute oral LD50 in rats greater than 5000 mg/kg. Essentially nontoxic.	Sodium linked to heart disease, hypertension. Cl causes unpleasant taste in drinking water. Mild skin and eye irritant. Acute Oral LD50 in rats approximately 3000 mg/kg. Slightly toxic. Contributes to winter road kills of wildlife.
Water Treatment Plants	No significant increase in BOD or impact on bacterial activity.	No significant impact at expected concentrations.
Air Pollution	Can reduce sand use and resulting particulate emissions.	Can reduce sand use and resulting particulate emissions.

Wildlife Conservation

When sodium chloride is used as a deicer, it can result in roads becoming salt licking stations for wild animals, particularly deer. CMA has been used in deer management areas of Scandinavia to prevent road accidents. In Finland, CMA mixed with sand at rates of 18-24 pounds per ton (15-20 kilograms per cubic meter) kept sand from freezing. Additionally this CMA rate was sufficient to deter reindeer from roadways. CMA has the aroma of vinegar, which does not appeal to animals.

Parking Structures

Cryotech CMA® works best above 20°F (-7°C) and is ideal for protecting new concrete.
CMA can be used on parking structures, sidewalks, parking lots, or any location where corrosion or new concrete is a concern.



As a non-chloride deicer, CMA helps protect your parking structure from corrosion and prevents maintenance costs. Chloride damage to parking structures is avoidable.

BENEFITS

Recommended by Consultants and Engineers:
Cost effective for your old, new, or repaired garage, as dollar estimates for a new garage range from $20,000 - $24,000 per space and repairs cost $3,000 - $4,000 per space

Non-chloride:
CMA provides cost-effective, long-term preservation, extend the life of your parking structure, and does not cause corrosion on automobiles parked in the structure

Effective Performance:
CMA works best above 20°F (-7°C) - without chloride corrosion

Staying Power:
Has a residual effect, requiring fewer applications

Minimal Tracking:
CMA does not track as much as common deicers

Stores Easily:
If stored properly, product does not clump and will spread with ease

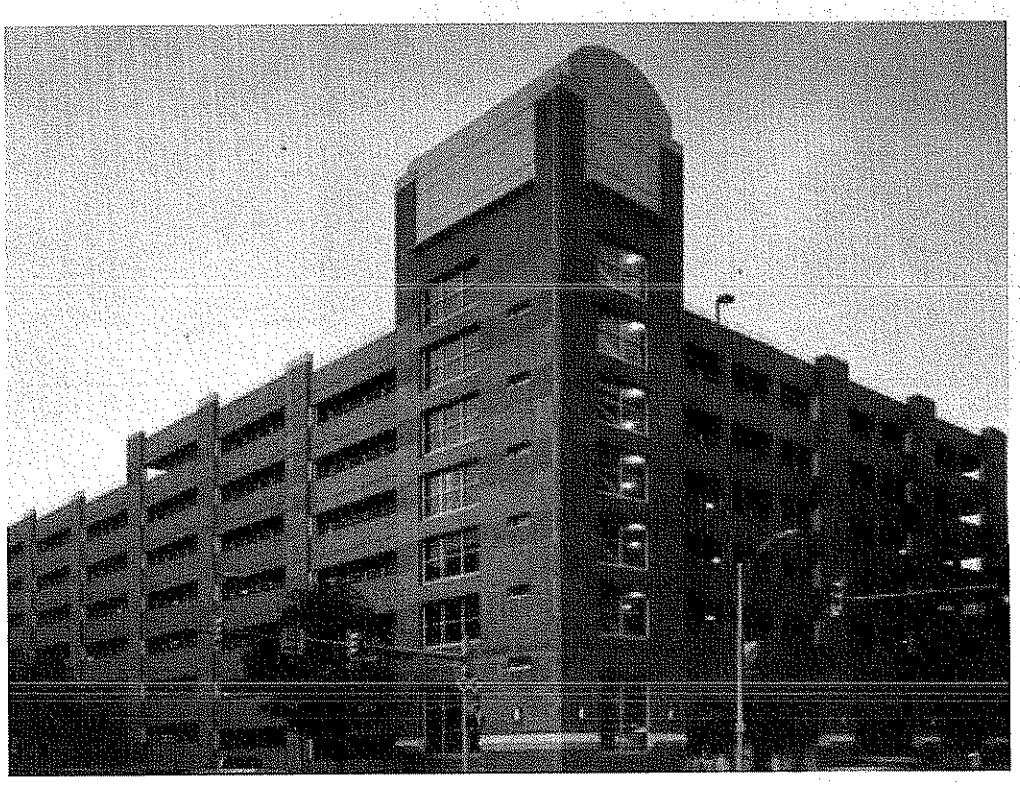
Safe for the Environment:
Low toxicity and biodegradable

Easy to Apply:
Applied with same equipment as other solid deicers

Concrete and reinforced steel's stability is compromised by damage due to corrosion and the freeze-thaw cycle of water. You can't protect your structure from Mother Nature, but you can protect it from chloride damage by using acetate-based CMA.

As a non-chloride deicer, CMA helps protect your parking structure from corrosion and prevent chloride-induced maintenance costs. This becomes increasing important as costs rise to maintain, repair, and rebuild parking structures. For more information on corrosion, please click here.

If concrete is new (less than one year old), then Cryotech CMA is recommended for the first year. After one year, we suggest Cryotech NAAC®.



Application Rates

CMA application rates vary according to climate and maintenance practices. CMA is applied at rates similar to road salt, but heavier in the first application and lighter as the storm continues. Typical application rates:

250 to 400 pounds per lane mile
5 to 15 pounds per thousand square feet
20 to 40 grams per square meter

CMA Customer Application Rates				
Agency	Location	Rate lb/ln mi	g/m2	Daily Traffic (vehicles/day)
MI DOT	Zilwaukee Bridge	300	24	45000
MA DPW	ROUTE 25	300	24	20000
CALTRANS	Mammoth Lakes	375	30	12000
Norway	Mjosa Bridge	375	30	7000
Japan	City of Sapporo	375	30	25000

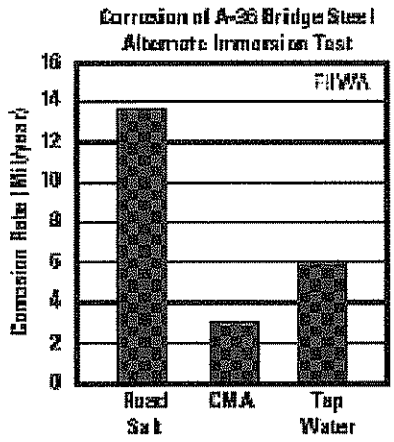
The bulk density of CMA is about 40 pounds/cubic foot compared to 70 pounds/cubic foot for salt. Since CMA is lighter, applications based on weight will appear to have 75% more pellets on the road surface compared to an equivalent application of salt.

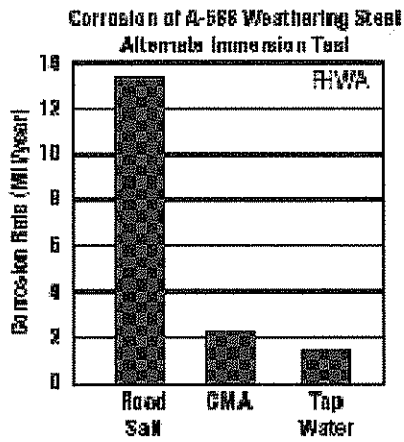
Corrosion Data

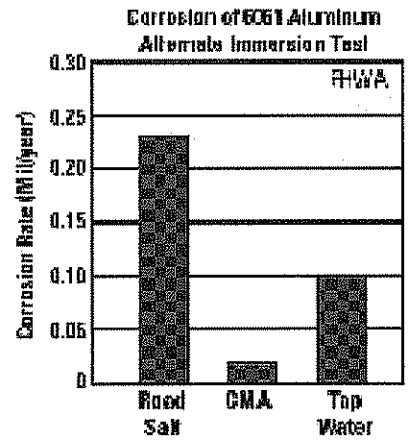
Corrosion Properties

CMA exhibits very low corrosion rates on metals found in bridges, roadways, parking garages, and other steel and concrete systems. Commonly described as being about as corrosive as tap water, CMA is often used as the corrosion standard by which other deicers are judged. Years of real-world use coupled with laboratory tests throughout the 1980's and 1990's sponsored by the U.S. FHWA, U.K Department of Transport, and other independent institutions have concluded: CMA is a proven low corrosion deicer.

Damage from chloride-based deicers

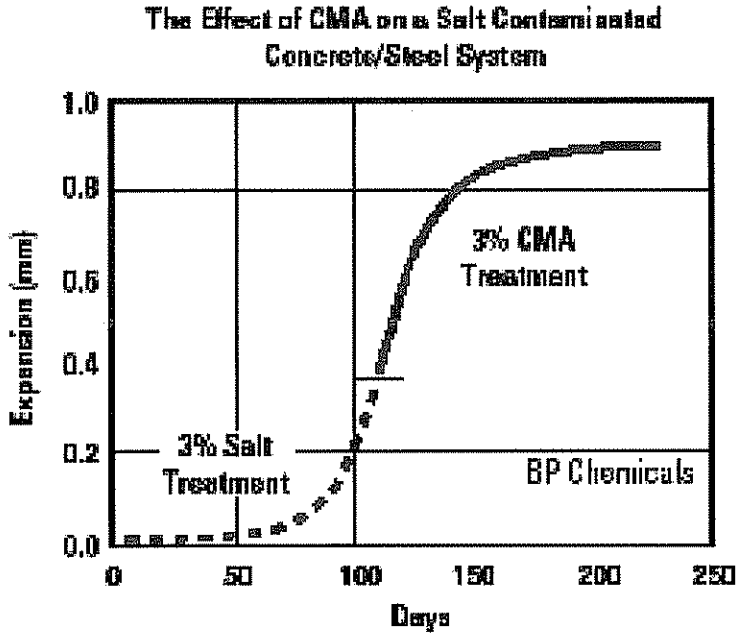




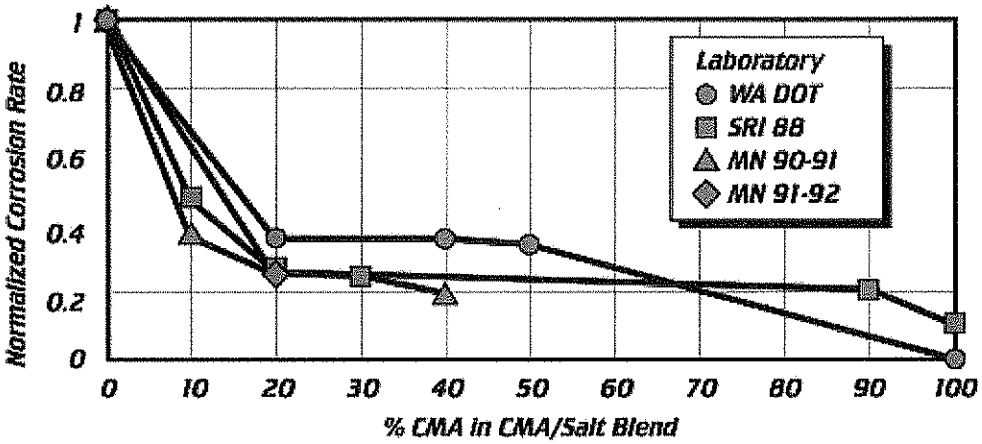


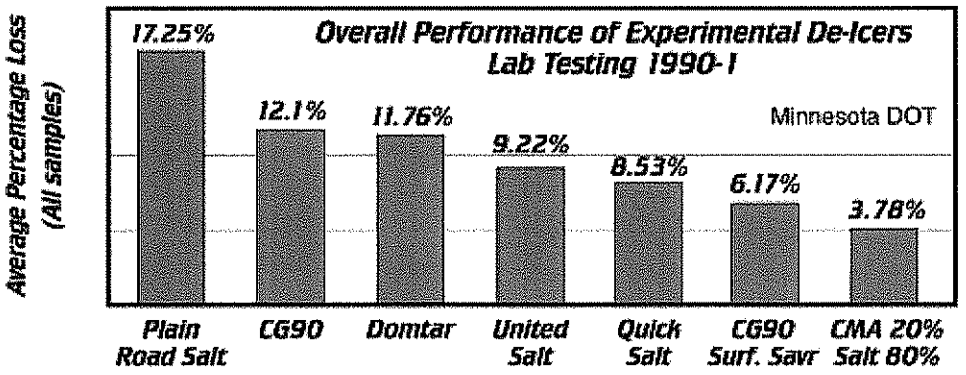
Corrosion Retardation

A switch to CMA on chloride-contaminated concrete structures may extend their useful life. Tests by the Denmark Ministry of Transport with steel rebar in chloride-contaminated concrete showed that when samples were treated with CMA solutions, corrosion rates were reduced. Later tests by BP Chemicals concluded: "CMA is non-corrosive towards steel reinforcement in concrete and can arrest incipient corrosion induced by prior use of rock salt deicers."

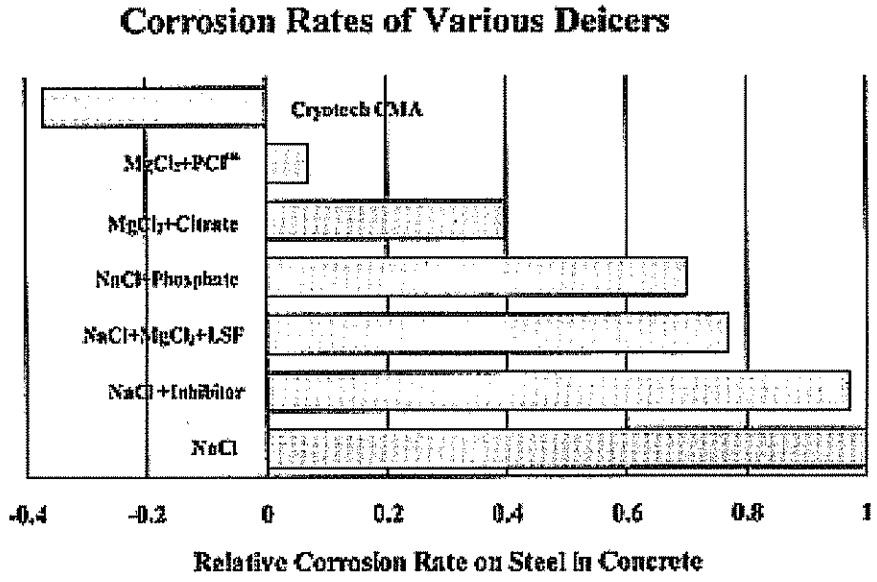


Corrosion Inhibitor





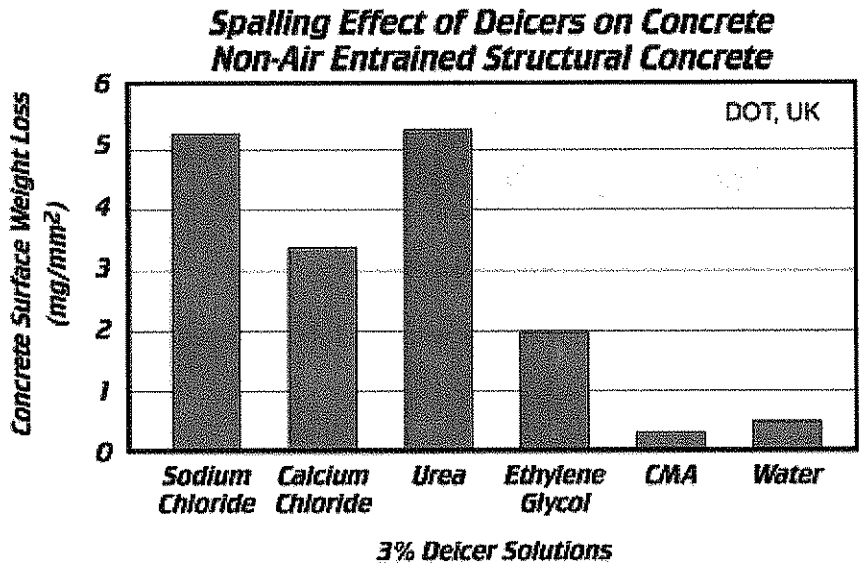
The FHWA evaluated the corrosion effects of various "inhibited" deicers with the following results:



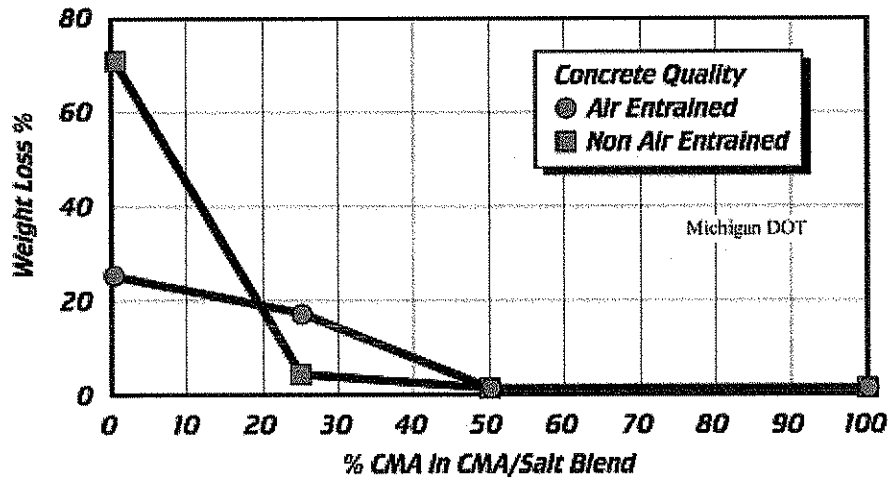
A number of laboratory tests suggest that CMA may be an effective corrosion inhibitor when combined with salt. Although tests were different in type and duration of exposure, all indicated that as little as 20% CMA in a CMA/salt blend resulted in a 70% to 80% reduction in corrosion. As expected, the best corrosion protection results from the use of pure CMA.

Concrete Compatibility

Many engineers specify CMA because it does not chemically attack concrete nor does it increase spalling caused by the freeze-thaw cycling of water. A U.K. Department of Transport study concludes: "With the exception of CMA, all of the deicing chemicals tested resulted in a greater deterioration of the concrete than water alone...CMA was the only chemical on weak structural concrete which satisfied the criterion for scaling damage."



Testing by Michigan DOT confirmed that CMA dramatically reduced spalling in both air-entrained and non air-entrained concrete compared to salt alone. Blending small amounts of CMA (minimum 20% by weight) with sodium chloride resulted in a reduction in salt-induced concrete scaling.



CMA Deicer Blends

A number of laboratory tests suggest that CMA may be used as an effective corrosion inhibitor when combined with salt. Although tests were different in type and duration of exposure, all indicated that a minimum of 20% CMA is needed in a CMA/salt blend to provide acceptable corrosion protection. Testing at 20% CMA and 80% salt resulted in a 70 to 80% reduction in corrosion over testing with pure road salt (sodium chloride). The best corrosion protection results from the use of pure CMA. For more information on corrosion, please click here.

In order to receive the maximum corrosion protection benefit from CMA deicer blends, it is important to verify the amount of CMA being used in the mixture. Cryotech CMA® is the only commercially available pure calcium magnesium acetate produced and sold in the United States. This product is often blended with other chloride deicers and marketed as "Containing CMA" when it actually contains only a negligible amount of pure CMA. Below are examples of how to insure you are receiving enough pure CMA in your deicer blend.

-**Read Labels Closely:** Many products state they are made with CMA yet only contain 1-2% CMA and the rest of the mixture is chloride-based. This small amount of CMA would be ineffective in stopping corrosion.

-**Ask Questions:** Your distributor should be able to provide the exact amount of each ingredient in the deicer blend to ensure you are receiving an adequate amount of pure CMA.

-**Double-Check Pricing:** If one price quote is much lower or higher than the others, be sure to ask the above questions to verify the same amount of CMA is being used in all products.

Customers also need to be aware that some products claim they contain CMA or calcium magnesium acetate but they actually contain a physical blend of **calcium acetate** and **magnesium acetate**. Cryotech CMA® is a patented formulation and each particle contains a specific ratio of calcium and magnesium. It has undergone significant testing to show it is safe for concrete.

Other Information

Applying liquid deicers to dry pavement will reduce friction between tires and the pavement surface. For this reason alone, user training is important prior to initial use.

Please contact Cryotech at (800)346-7237 or (319)372-6012, or email.

CMA Comes In Various Forms

CMA
Cryotech provides CMA in bulk, 1 metric ton (2205 lb) supersacks, or 25 kg (55 lb) bags. CMA should be used at temperatures above 20°F (-7°C). CMA should be stored indoors or in weather-proof containers. Covering bulk CMA is advised in high humidity areas. When properly stored, CMA will remain effective for years.

CMA Salt Blends
Cryotech provides CMA and a high quality grade of salt pre-blended in a CMA concentration of 40% (CMA40®). This product is recommended where protection from corrosion and concrete spalling is needed, but limited quantities of salt can be tolerated. CMA/salt blends should be stored with the same precautions as CMA.

Liquid CMA
A 25% CMA solution can be prepared by mixing Cryotech CMA at a rate of 3 lb/gal (0.38 kg/l) of potable water. At higher concentrations some CMA may not dissolve. At 25% concentration, CMA has a gel point of 8°F (-13°C), a eutectic point of 4°F (-16°C), and specific gravity of 1.14. Detailed mixing instructions are available - call Cryotech with questions.

Liquid CMAK®
Cryotech provides liquid CMA enhanced by the addition of Cryotech CF7, a potassium acetate-based deicing product. The end-product, trade named Cryotech CMAK, has a lower freezing point than liquid CMA, yet carries many of its corrosion and environmental benefits. CMAK is recommended for use in automated anti-icing systems like that pictured below. Containing no chlorides, it combines the low-corrosion properties of CMA with the high performance of potassium acetate. Contact Cryotech for freeze-point specific formulations. CMAK is a patented product - customers wishing to blend it in the field may be granted authorization from Cryotech to do so. See MSDS for additional information.

Bibliography

Following please find a list of technical information with a brief description following thereafter.

1. Amerhein, C. and Strong, J. E., The Effect of Deicing Salts on Trace Metal Mobility in Roadside Soils. In Proceedings of: The Environmental Impact of Highway Deicing, University of California, Davis, California, October 1989.

As an alternative to NaCl, calcium magnesium acetate (CMA) is gaining popularity in selected areas around the country and in California. Calcium magnesium acetate at a Ca/Mg ratio of 3:7 has been found to be the most effective deicer (Schenk, 1985) and is less toxic to fish, zooplankton, and phytoplankton and less corrosive than chloride salts (Horner, 1988).

The effect of calcium magnesium acetate on trace metal mobility in roadside soils should generally be beneficial. The acetate provides some pH buffering and the decomposition of acetate produces HCO3, which will increase the pH of the soil and decrease the solubility of trace metals coprecipitated with oxides, hydroxide, and carbonate. The Ca and Mg ions are beneficial to soil structure, maintaining the porosity and aggregate stability whereas Na tends to destroy soil structure. Mobilization of dispersed clays and organic matter occurs when adsorbed Na is high and the ionic strength is low. Thus, dilute solutions of NaCl and pure snowmelt are likely to mobilize metals through the process of organic matter solubilization and clay dispersion.

2. Connolly, J. P., Analysis of the Environmental Fate of ICE-B-CON® and its Impact on Receiving Water Dissolved Oxygen, HydroQual, Inc., Mahwah, New Jersey, April 1990.

The biodegradation kinetics in natural waters and soils of the acetate in a calcium magnesium acetate (CMA) formulation developed by Chevron Chemical Company and marketed under the trade name ICE-B-GON® were quantified from laboratory experiments. These kinetics were used to project the impact of this CMA on the dissolved oxygen of receiving waters. The laboratory experiments indicated that the degradation process may be quantified as a first-order reaction in which the degradation rate is a function of temperature and microbial activity. Model simulations indicated that significant load reduction can occur as a result of acetate degradation in soil as highway runoff passes over field prior to entering a receiving water. In an alternate scenario in which the CMA accumulates in the snowpack and does not begin to degrade immediately, the potential for a significant impact is increased.

3. Dobson, M.C., The Effects of Salt (NaCl) and Calcium Magnesium Acetate (CMA) on the Growth of Various European Tree Species, Preliminary Report, Forestry Research Division, Farnham, Surrey, United Kingdom, 1990.

A limited number of tree species have been screened for tolerance to CMA, and those that have been tested are not planted in significant numbers in Britain. This preliminary report outlines the results obtained to date from research, partly funded by BP, into the effects of NaCl and CMA on the growth of various European tree species. It contains data on parameters of tree growth and soil ion concentrations. The final report will contain additional data on foliar analysis and will include a full discussion of the results.

4. Horner, R. R., Environmental Monitoring and Evaluation of Calcium Magnesium Acetate (CMA), National Cooperative Highway Research Program Report 305, Transportation Research Board, National Research Council, April 1988.

This report contains findings from research to examine the environmental effects of calcium magnesium acetate (CMA) through laboratory and field experimentation. Previous research by others has suggested CMA as an alternative to the commonly used chloride-bearing highway deicers. With the completion of this study, state highway agencies considering the use of CMA now have access to information on its environmental effects. Specific guidance have been developed, and, in the few instances where research results are not definitive, field monitoring plans are suggested for use when circumstances dictate a conservative approach to the application of CMA.

5. Jones, P. H., et al., Environmental Impact of Road Salting, Institute of Environmental Studies, University of Toronto, July 1986.

The purpose of this report is to provide a comprehensive resource document concerning the environmental impacts of road salt. This document will be of use to MTC Regional Environmental Planners in assessing the impacts of road salting activities on ground and surface water quality, and terrestrial aquatic biota. Alternatives to the use of sodium chloride are not considered.

6. Leiser, A. T., John, S. A. Evaluation Of The Effects of Calcium Magnesium Acetate on Selected Plant Species, In Proceedings of: The Environmental Impact of Highway Deicing, Department of Environmental Horticulture, University of California, Davis, California, October 1990.

The two deicing agents (CMA and NaCl) were applied in solution to soils and by spray to plant tops to investigate the possible effects of CMA to roadside vegetation using NaCl as the control. Soil application rates were selected to bracket the rates of NaCl actually applied to highways so that soil concentrations would equal, and at the highest rate, exceed those attained in soils within 25 feet of the roadway. Spray application rates were selected in the range and to exceed the concentrations found in snowmelt actually sampled from highway surfaces. One plant of each species was included in each replicate as a non-treated control.

7. Pollock, S. J., Mitigating Highway Deicing Salt Contamination of Private Water Supplies in Massachusetts, In Proceedings of: The Environmental Impact of Highway Deicing, University of California, Davis, California, October 1989.

The purpose of this report is to document the effectiveness of two of the preventive and remedial actions that are used by MDPW to alleviate salt contamination of private water supplies. These actions are reducing salt on state highways and use of salt substitute, calcium magnesium acetate.

8. Washbrook, D. M., Investigation into the Effects of BP Clearway CMA on the Activated Sludge Process at Rye Meads Sewage Treatment Works, Thames Water, March 1989.

The results of this test have shown no detrimental effects on sewage treatment, and it is unlikely that any problems would be encountered if the use of Clearway CMA became widespread.

9. Winters, G. R., et al., Environmental Evaluation of Calcium Magnesium Acetate (CMA), Report No. FHWA/RD-84/094, California Department of Transportation, June 1985.

This report presents the results of a literature survey and a limited laboratory study on the environmental impacts of Calcium Magnesium Acetate (CMA). Laboratory tests were performed on fish, zooplankton, phytoplankton, common roadside plants and soils. No information was found on surface water quality, groundwater quality, or air quality. CMA is less toxic than NaCl to Rainbow trout, Fathead Minnows, and most plant species tested. CMA is not toxic enough to prevent it from being used as a deicer. Recommends additional studies to determine how CMA impacts natural systems.

10. Chollar , B. H. and Virmani, Y. P., Effects of Calcium Magnesium Acetate on Reinforced Steel Concrete, Federal Highway Administration, Public Roads Vol. 51, No. 4, March 1988.

Results indicated that the potential of the black steel rebars in slabs ponded with salt solutions started increasing numerically within the first 3 months of exposure, while that of rebars in slabs ponded with CMA solution did not increase at all during that time period. The CMA solutions did not cause any significant potential shift or corrosion after 4 years on/off ponding in an outdoor environment.

11. Chollar , B. H. and Virmani, Y. P., Effects of Calcium Magnesium Acetate on Reinforced Steel Concrete, Federal Highway Administration, Public Roads Vol. 51, No. 4, March 1988.

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12. Locke, K. E. and Kenneley, K. K., Corrosion of Highway and Bridge Structural Metals by CMA, Federal Highway Administration Report FHWA/RD-86/064, June 1986.

This report describes a study of the corrosive tendencies of reagent grade calcium magnesium acetate (CMA) and a commercial grade CMA on metals used in bridge construction including reinforcing steel on concrete. The results of an electrochemical and exposure study indicate CMA is much less corrosive to the exposed metals than found with sodium chloride.

13. Man, M.C.M., Hazell, L.B., Smith, R.P., On-Line Measurement of Simulated Reinforcement Corrosion in Concrete Under Action of De-Icers, British Petroleum Research Center, London, U.K., October 1989.

It has been demonstrated that, compared to rock salt, acetate deicers are at least a factor of ten times less corrosive towards steel reinforcement in a model concrete. Changing from rock salt to acetate deicers should extend considerably the lifetime of steel reinforced concrete elevated highways and bridge structures, even those already damaged by previous use of rock salt.

14. Nadezhdin, A., et al., The Effect of Deicing Chemicals on Reinforced Concrete, Domtar Inc., Senneville, Quebec, Canada, Domtar Chemicals Group, Sifto Salt Division, Mississauga, Ontario Canada, Report to Transportation Research Board, January 1988.

This paper addresses the role played by deicing chemicals in the deterioration of reinforced concrete. The use of rock salt as a deicing chemical has given rise in the last few years to important environmental concerns because of the potential damage to concrete pavements. Several newer and faster bench scale methods of study and materials evaluation are described and compared to the ASTM recommended techniques. The difference in freezing temperatures between concrete pore solution and an outside deicer solution is shown to be one of the important factors in the spalling process. The importance of an anisotropic character of freezing zone is also outlined.

15. Slick D.S., Effects of Calcium Magnesium Acetate (CMA) on Pavements and Motor Vehicles, Federal Highway Administration Report FHWA/RD-87/037, April 1987.

This report describes a study of the effects of reagent grade and commercial grades of calcium magnesium acetate (CMA) on all non-metallic materials used in highway and bridge construction and on all motor vehicle parts. The results of this study indicate CMA has much less effect on the non-metallic highway materials and motor vehicle parts than found with sodium chloride.

16. The Danish Corrosion Center, Effect of CMA on Corrosion Properties of Rebar in Concrete, Denmark Ministry of Transport, December 1990.

This study investigated the effect of CMA on corrosion of steel reinforcement in salt contaminated concrete. The results of the study show that the application of CMA to concrete already contaminated with chloride delays the onset of corrosion. This work, along with recent studies by the Michigan Department of Transportation, BP Chemicals Ltd. in the United Kingdom and the Federal Highway Administration, confirms the corrosion inhibiting properties of CMA in concrete.

17. Fleege, E., Salt Additives and Alternatives Corrosion Study, Minnesota, Department of Transportation, May 1991.

The Minnesota Department of Transportation has committed itself to the development of methods and techniques to reduce the negative aspects associated with deicing agents and still maintain current levels of service during the winter for the traveling public. This is being accomplished by either of two (2) methods; either to reduce the corrosiveness of the de-icing materials and/or to reduce the risk of group water contamination by reducing the amount of sodium chloride that is used as a de-icing agent.

18. Bacchus, A., Financial Implications of Salt vs. CMA as a Deicing Agent: Cost & Benefits Estimated by an MTO Expert Group, The Research and Development Branch, Ministry of Transportation of Ontario, December 1987.

It is salt which historically has been used to keep Ontario roads passable and safe in winter for commercial, commuter, and recreational traffic. Salt is very effective as a deicer and costs relatively little per ton, but it is known to have damaging effects on vehicles, reinforced concrete highway bridges, parking garages, groundwater, vegetation, and other private property. MTC continues to seek methods of reducing salt usage and to search for affordable alternative deicers that are more benign to the environment. Calcium Magnesium Acetate (CMA) has been identified as one of the most promising alternative deicers.

19. Hudson, Lawrence R., Calcium Magnesium Acetate (CMA) from Low-Grade Biomass, Paper, Presented at IGT Conference, Energy from Biomass and Wastes XI, Orlando, March 18, 1987.

Calcium Magnesium Acetate (CMA) is an alternative to salt for highway deicing. It was selected by the Federal Highway Administration (FHWA) as the long-term deicing material of choice based on several characteristics. Compared to salt, CMA is less corrosive, less damaging to concrete, and less harmful to plant and animal life.

20. Murray, D. M., Ernest, U.F. W. An Economic Analysis of the Environmental Impact of Highway Deicing Report No. EPA-600/2-76-105, Environmental Protection Agency, May 1976.

This study involves an analysis of the cost of damages that result from the use of salt (sodium chloride and calcium chloride) on highways to melt snow and ice. A large literature search and several surveys were carried out in order to determine the types and extent of damages that have occurred. This report contains over 320 references.

21. Nottingham, D., et al., Costs to the Public Due to the Use of Corrosive Deicing Chemicals and a Comparison to Alternate Winter Road Maintenance Procedures, Report No. AK-RD-84-14, Alaska Department of Transportation and Public Facilities, December 1983.

This paper represents a pragmatic attempt to quantify salt related damage to vehicles and bridges in the Anchorage area and to examine possible means of reducing the use of salt. Total program cost, as used in this report, includes direct and initial costs and indirect costs of loss of vehicle value and damage to bridge decks. The major avenues examined for reducing the total costs of the present Anchorage deicing program are: utilize heated storage buildings and stockpiling sand and replace salt with non-corrosive deicing chemicals. These options were selected based on simplicity, feasibility for the study area, and production of results similar to current maintenance procedures.

22. Vitaliano, D. F., An Economic Assessment of the Social Costs of Highway Salting and the Efficiency of Substituting a New Deicing Material, Rensselaer Polytechnic Institute, Economics Department, Troy, New York, February 1991.

The use of salt for deicing roads results in costs estimated at more than $800 per ton, including the costs of repair and maintenance of roads and bridges, vehicle corrosion costs, and loss of aesthetic value through roadside tree damage. Additionally, there are probable health costs related to elevated sodium levels in drinking water. The new Surface Transportation Act of 1991 appears to replace the previous federal funding policy that was biased against the use of calcium magnesium acetate (CMA) with a new subsidy for its purchase that may lead to inefficient overuse.

23. Transportation Research Board Special Report #235 Comparing Salt and Calcium Magnesium Acetate," 1991.

The damaging and corrosive effects of road salt on cars and highways, as well as its impacts on terrestrial and aquatic ecosystems, have prompted investigations on a variety of alternative deicing compounds. These studies have revealed that calcium magnesium acetate (CMA) may prove to be a good alternative to sodium chloride. Before CMA can be used on a large economic scale, however, investigations of its effects on various aquatic and terrestrial roadside environments are needed. In this investigation, samples were taken from each of the ten lakes and were then incubated in situ with various concentrations of CMA to determine if there are any effects on natural lake phytoplankton growth. Within the scope of this investigation, CMA seems to have no or relatively small effect on phytoplankton biomass.

24. Elliott, H. A. and Linn, J. H., Effect of Calcium Magnesium Acetate on Heavy Metal Mobility in Soils, Agriculture Engineering Department, Pennsylvania State University, Journal of Environmental Quality 16(3), 1987.

Calcium Magnesium Acetate (CMA) is a promising replacement for traditional roadway deicing salts. CMA was studied to assess its impact on the mobility of metals in contaminated soils. Under the experimental conditions, acetate complexation played a minor role in metal mobilization. Highway deicing with CMA may temporarily increase translocation of metals in strongly buffered acid roadside soils. Input of acetate ions and an increase in exchangeable bases with sustained CMA use should render northeastern USA soils less vulnerable to acidification, thereby inhibiting conditions that promote metal solubilization.

25. Goldman, C. R., Environmental Effect of Calcium Magnesium Acetate on Natural Phytoplankton Populations in Ten Sierra Nevada and Klamath Mountain Lakes, In Proceedings of: The Environmental Impact of Highway Deicing, University of California, Davis, California, October 1989.

Sodium chloride, or common road salt, is by far the most popular chemical deicer, because it is reliable, inexpensive, and easy to handle, store and apply. Over the years, however, the widespread use of salt has been linked with many indirect costs, including damage to motor vehicles, infrastructure, and the environment. Recognizing these drawbacks, in 1980 the Federal Highway Administration identified calcium magnesium acetate (CMA) as a possible replacement for salt. Results have been promising, but the most significant impediment to its use has been its price, which is more than 20 times that of salt.

Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

Non-chloride Calcium Magnesium Acetate (Cryotech CMA®), Sodium Acetate (Cryotech NAAC®), and Potassium Acetate (Cryotech CF7®) are eligible for matching Federal Funds under the SAFETEA-LU act that was passed in August 2005. Through the SAFETEA-LU act, funds are available for low corrosive anti-icing/deicing applications and environmentally preferred anti-icers/deicers used on highway bridges through 2009. This act is building on the foundation provided by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century of 1998 (TEA-21), which originated to help preserve and rehabilitate America's bridges. There is approximately $21.6 billion authorized through 2009 for the Highway Bridge Program section of the act.

For more information regarding the SAFETEA-LU act, please visit http://www.fhwa.dot.gov/safetealu/index.htm.

CRYOTECH CMA®
SOLID COMMERCIAL DEICER

CRYOTECH

Questions & Answers

What is CMA?
Cryotech CMA® is solid calcium magnesium acetate, a low-corrosion, environmentally safe deicer. It is used on roads, bridges, parking garages, and corporate campuses, or wherever corrosion, concrete damage, or the environment are of concern. CMA can also be liquefied in the field for anti-icing applications.

How is CMA made?
CMA is a simple combination of dolomitic lime and acetic acid (a principal component of vinegar). CMA is produced Cryotech's plant in Fort Madison, Iowa.

Why was CMA developed?
There has long been a concern for damage to the environment and to structures like bridges and parking garages cause by the use of chloride deicers. In the 1970's, the Federal Highway Administration (FHWA) identified calcium magnesium acetate as the only low-corrosion chemical alternative to road salt that also protected the environment. Years of research and field applications have proven CMA is no more corrosive than tap water and does not harm vegetation or receiving waters.

How does CMA work?
CMA, like road salt, works best above 20°F (-7°C), and is used at about the same rates as salt. Applied early in the storm, CMA prevents the formation of snow pack and the bonding of ice to the pavement surface. CMA interferes with the ability of snow and ice particles to adhere to each other or to the pavement, and therefore, the loose residue can be easily removed by broom or plow.

A key to successful use of CMA is a thorough understanding of the deicer's performance characteristics. Trained and experienced operators quickly adapt their applications and plowing techniques to take advantage of CMA's unique properties.

How can CMA be used?

- CMA can be used straight for direct application.
- CMA can be prewet with Cryotech CF7® Liquid Commercial Deicer (potassium acetate-based) to enhance its performance.
- CMA can be mixed with sand for direct application at various concentrations or to prevent the sand pile from freezing.
- CMA can be mixed with salt to reduce the corrosive nature of salt and reduce the volume of salt applied.
- CMA can be liquefied for use as a prewetting agent or for direct anti-icing applications

How long does CMA last?
CMA tends to remain on the pavement surface longer than ordinary deicers, working longer to prevent bonding. This residual action reduces application frequency and makes snow removal easier.

The refreeze temperature of CMA solutions rises slower than dilution than sodium chloride, calcium chloride, or magnesium chloride. This feature makes it well suited for anti-icing treatments, especially for use in the pretreatment of bridge decks in anticipation of frosting, or localized icing conditions.

Does CMA require any special handling or equipment?
No, CMA is applied with the same equipment as other deicers. Furthermore, CMA can be stored indefinitely when kept dry.

Does CMA affect health?
CMA is essentially non-toxic. A series of oral inhalation, eye, and skin tests conducted in accordance with the U.S. Environmental Protection Agency (EPA) guidelines classify CMA as no more harmful to handle than common table salt.

Does CMA affect the environment?
When absorbed into the soil, CMA's calcium and magnesium components benefit the soil structure, just as limiting a garden improves permeability. The acetate portion of CMA biodegrades naturally.

Does CMA cause corrosion on roads, bridges, parking garages, etc.?
No significant corrosion of steel, aluminum, or concrete has been found in repeated tests with CMA sponsored by the FHWA, state Departments of Transportation, and private researchers.

Does CMA act as a corrosion inhibitor?
Laboratory studies have shown that CMA, when mixed with sodium chloride at a minimum 20% by weight, inhibits salt's naturally corrosive properties. Additionally, CMA reduces active corrosion when applied on chloride-contaminated structures, extending their useful life.

Does CMA reduce corrosion more than inhibited chloride products?
Yes, CMA is essentially non-corrosive. FHWA studies conclude that no inhibited deicers compare with CMA in minimizing corrosion to steel imbedded in concrete.

Is CMA safe for concrete?
CMA does not chemically attack concrete, nor does it increase spalling cause by the freeze/thaw cycle of water. A study by the UK Department of Transportation concludes: "With the exception of CMA, all of the deicing chemicals tested resulted in a greater deterioration of the concrete than water alone...CMA was the only chemical on weak structural concrete which satisfied the criterion for scaling damage."

For more information about Cryotech CMA®, visit:
www.cryotech.com

Frequently Asked Questions

How much does CMA cost?
The purchase price of CMA is more than salt. However, independent studies have concluded the life-cycle costs of salt can be as high as $3000 per ton ($3.30/kg) when considering corrosion damage and environmental impact.

Is there government awareness of CMA?
Yes, the U.S. Federal Government allows for matching federal funds. In 1991, Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA) providing states with 80% reimbursement for use of CMA on bridges, overpasses, and approaches. In 1998, the TEA-21 Act (Transportation Equity Act for the 21st Century) reaffirmed this reimbursement. Again in 2005, the federal government showed continued support by passing the SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy of Users). The FHWA has funded research to find inexpensive methods to produce CMA from biofermentation processes.
Additionally, California, Massachusetts, Michigan, Nevada, New York, New Hampshire, and Vermont have all passed legislation concerning environmentally freindly deicers like CMA.

Is Cryotech ISO certified?
In 2002, Cryotech's Fort Madison, IA plant achieved ISO 9001:2000 certification for its quality process sytems, having been previously registered to ISO 9000:1994. ISO is an internationally recognized quality model. It provides assurance to customers that the products they receive are produced and shipped under rigorous international quality standards. In 2005, Cryotech also became an ISO 14001:2004 certified company, which is primarily concerned with what the company is doing to minimize the environmental effects of its activities. Every year Cryotech is audited by an independent registrar to ensure it is continually improving its processes and maintaining the ISO standards. Cryotech is the first manufacturer in North America in its industry to receive certification to these two standards.

Who are some of the users?
A small sampling:

Cities
Arlington Heights, IL
Bellevue, WA
Columbus, OH
East Lansing, MI
Essexville, MI
Oak Lawn, IL

State DOT's
TN, TX, WA, WV
Pennsylvania Turnpike

Commercial
Blue Cross Blue Shield
Cox Health Systems
Kentucky, University of
Lewis Gale Hospital
Midwest Snowfighters, LLC
Morristown Parking Authority
Park Square Revival
St. Mary's Hospital

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For concrete:

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Amrhein, C., and Strong, J.E., The Effect of Deicing Chemicals on Major Ion and Trace Metal Chemistry in Roadside Soil, in proceedings of: The Environmental Impact of Highway Deicing, UC-Davis, 1989
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