UW-0097#1

Send copies to SHAC

cc MRP / KRN / JEL / CPM FYI

Send copy to: LE Current / SW Clark / GB Tolley / RW Engle / SS Mayhree

PLAINTIFF'S EXHIBIT

UC-4316

UNION CARBIDE CORPORATION
ENGINEERING, MANUFACTURING AND TECHNOLOGY SERVICES DEPARTMENT
HEALTH, SAFETY AND ENVIRONMENTAL TECHNOLOGY
South Charleston, West Virginia

BUSINESS CONFIDENTIAL MEMORANDUM
May 19, 1987

RECEIVED
MAY 21 1987
CCN

RECEIVED
MAY 27 1987
S. W. CLARK

TO: T. L. Grittie - 380, Bldg. 2000
G. W. Wulfert - 380, Bldg. 33
W. J. Vincent - 514, Bldg. 109-2
J. R. Dement - 514, Bldg. 309-2

COPY: D. A. Gosselin - 514, Bldg. 82
C. C. Neely - 511, Bldg. 2000
P. R. Kavasmaneck - 511, Bldg.2000

FROM: T. E. Hanning

SUBJECT: FOR YOUR INFORMATION AND USE
ASBESTOS REMOVAL WORK

Mr. Roger W. Hornbaker, a representative of Project Development Group, Inc. (PDG), met with me last week and discussed his company's willingness to bid on asbestos removal work within West Virginia. PDG is based in Pittsburgh and has performed asbestos removal jobs in Newport News, Virginia and Chicago.

PDG is insured for asbestos work and bondable, if required. Bids will be offered on a lump sum or time and material basis. All air monitoring results will be performed in certified AIHA labs. Credentials and pre-qualification information will be sent upon request.

As asbestos removal becomes necessary, you may wish to include PDG in the bidding process.

Sincerely,

Terry E. Hanning
2000/3328
Extension 5903

TEH
05/19/87

Project Development Group, Inc.
10 Duff Road Pittsburgh, PA 15235
412-243-3100

Roger W. Hornbaker

Asbestos Assessment and Abatement

RECEIVED
JUN 2 1987
C. P. MAXWELL

UCC 011406

UNION CARBIDE

BUSINESS CONFIDENTIAL

INTERNAL CORRESPONDENCE

cc: J E Calvert
L E Nicol
M A Patel
P D Greeg
C P M

FYI

RECEIVED
JUN 4 1987
C. P. MAXWELL

POLYOLEFINS

P. O. Box 8004
Bldg. 82, 4th Floor
South Charleston, WV 25303

TO: L. E. Calvert
CLEAR LAKE

DATE: June 3, 1987

FROM: T. P. Raby

ORIG. DEPT: POD - SHARE

CC:
H. G. Anderson, Seadrift Plant
S. W. Clark, 2000/3221 (511)
V. D. Dutcher, Cary, NC
S. T. Eberhardt, Bldg.98, Bound Brook
D. H. Fysh, Montreal
D. A. Gosselin, 82/9 (514)
R. E. Graebert, M3531, Danbury
V. H. Johnkoski, 82/4 (514)
C. T. Lawson, 781/205 (511)
J. B. Leverton, Texas City (515)
T. E. Liles, Seadrift Plant
D. C. Macauley, P4610, Danbury
B. A. Mallory, Star (306)
C. P. Maxwell, 701/256 (511)
O. P. Mukheja, L4492, Danbury
J. E. Neff, 740/4326 (511)
J. D. Nicol, P2617, Danbury
R. D. Ondocsin, P2625, Danbury
R. R. Rankin, P2605, Danbury
A. M. Robertson, Prentiss Plant
C. R. Rotthoff, 82/9 (514)
K. D. Stotler, Star (306)
S. W. Turicchi, M4, Danbury
G. A. Viera, 2000/3201 (511)

SUBJECT: Safety Alert - May 27, 1987

I have read your "Safety Alert" and do not agree with your statement that "the enclosures [built for work on asbestos containing materials] are confined spaces and need to meet your location [confined space] requirements." The enclosure may or may not have to be treated as a confined space based on each specific case. If the enclosure were in a pit deeper than 4 feet, or within a room/area previously designed as a confined space, etc., it would be a confined space under the existing "confined space" definition.

One must realize that whenever you build any type of enclosure within a chemical plant you must be cognizant of the fact that a hazardous atmosphere may be created instantaneously (release of a safety relief device, flange rupture, etc.) or slowly over time (such as minor leak, disturbing flammable/toxic materials within the enclosure, etc.). Thus, creating an asbestos removal enclosure in a unit must be very carefully thought out and safety reviewed by competent individuals. In all cases, I have highly recommended to our POD location safety and health managers (unless of course the enclosure has been designated a confined space and then the full confined space entry requirements must be met) that:



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1. Prior to each daily entry into a negative pressure enclosure and each time it is reentered after "breaks" and periods following blower shutdown that LEL, oxygen, and toxicity (if warranted) tests be taken to assure entry is being made into a safety atmosphere.

2. Each job requiring the use of a negative pressure enclosure be carefully evaluated, and where the enclosure encompasses a known potential hazard such as a vent, safety relief device, etc., that continuous LEL/$O_2$ monitoring be conducted.

   [Note: We do not require a standby attendant, emergency equipment, etc., that are required by the "Confined Space Policy".]

   Again, to reiterate, it is my contention that not all asbestos removal negative pressure enclosures are confined spaces by definition as your safety alert infers. They may or may not be confined spaces based on their physical location or construction characteristics.

Considering the aforementioned, I would recommend that you immediately clarify this "confined space" misconception with the recipients of the Safety Alert, especially the location Maintenance Department Heads.

The Safety Alert as written appears to establish a C&P standard - namely, all negative pressure enclosures used in the asbestos removal process are confined spaces. At best, it could be causing confusion at the location (Maintenance interpretation versus Safety Group interpretation), and at worst, it could cause a plant to unnecessarily receive an OSHA citation and spend time on subsequent litigation.

Should you have any questions on this subject, please give me a call.

Regards,

Tom Raby

T. P. Raby

TPR/jgh,1755B/D85B



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Ocnec JAF CRM LRN @ JEL

JAP

UNION CARBIDE CORPORATION
Engineering, Manufacturing & Technology Services

1300 Hercules Avenue - Suite 202
Houston, Texas 77058

RECEIVED
MAY 4 1987
T. L. COLLINS

RECEIVED
MAY 1 1 1987
J. A. FEY

Date: April 28, 1987

To: See Attached Distribution List

Copy to: See Attached Distribution List

Subject: Asbestos Gasketing and Packing

Rapid changes in the asbestos area are taking place and the rate of change will probably stay high until the majority of asbestos is replaced. This communication is an overview of current activities to help you meet regulatory requirements.

A task group (C. Neely, et al) dealing with the phase-out of asbestos containing materials in the work place for C&P, made their recommendation to the Manufacturing Council via B. G. Perry, and it was approved in March, 1987. (Recommendation attached) A key recommendation was termination of purchase of asbestos containing materials, after January 1, 1987.

During the development of the original recommendation, the supply world has changed. UCC's three major suppliers are no longer manufacturing asbestos containing materials. No supplier is willing to make a firm commitment to supply asbestos containing materials after the end of 1987, because of the inability to get liability insurance. In addition, the cost of asbestos has gone up 25% in the last twelve months. Therefore, the recommended deadline for purchase cessation may be met by lack of supply.

- continued -



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In order to help prepare for this change-over, the following actions are in progress:

1. The task force has initiated and expedited actions to do the engineering specification work for asbestos replacements for gasketing and packing. These C&P Engineering Standards will be available for each location by September, 1987. Specific questions before then should be discussed with Rex Engle at the South Charleston Tech Center.

2. Manufacturing Services - Maintenance working with UCC Carbon Products and Texas City Plant Maintenance is developing a video tape of "How-To's" for Grafoil installation in gasketing and packing applications. This videotape will be available thru Manufacturing Services - Maintenance in June, 1987 and you will be notified later how to obtain it. The videotape is designed to simplify the work of training your people. In addition to the use of the videotape, it would be wise to contact Jim Polomsky of Carbon Products to provide further follow-up, Hands-On Training. (713+852-9468 - Home - Houston, Texas or 1-800-822-4322 - Office - Cleveland, Ohio). See attached seminar content detail.

3. Exposure level data for situations of removing, cutting, and handling gasketing and packing is now being collected from several locations by Industrial Hygiene. With these data, the appropriate removal methods can be specified. Industrial Hygiene coordination of this data collection program should eliminate the need for each location collecting data.

4. We are representing maintenance for all C&P locations in the on-going review of the OSHA field compliance Instructions Draft. As conclusions are drawn we will let you know.

We are coordinating these efforts in order to speed communications and minimize the efforts for each location. For further assistance, please call Ashton Barefoot at UNICOM 529-6437 or 713+486-6437.

Larry

L. E. Calvert

LEC/6262L/cc



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UNION CARBIDE

INTERNAL CORRESPONDENCE

Engineering, Manufacturing, and Technology Services
Central Engineering
Technical Center

Post Office Box 8361
Building 2000
South Charleston, WV 25303

October 16, 1986

TO: Mr. L. E. Calvert
Mr. S. W. Clark
Mr. G. B. Elder
Mr. R. W. Engle

COPY TO: Mr. C. C. Neely

SUBJECT: Recommended C&P Program - Phase-Out Use of Asbestos-Containing Materials in Workplace

Gentlemen:

Attached is a copy of your recommendation covering asbestos usage which I transmitted to Bob Perry.

Thanks for your insights and efforts in pulling this together. I'll keep your team posted as the recommendation proceeds through the system.

Very truly yours,

J. E. Sanders

JES:he
Attachment
4704Y

UCC 011411

OCT 15 1986

UNION CARBIDE CORPORATION
Engineering, Manufacturing, and Technology Services
Central Engineering

P. O. Box 8361
So. Chas., WV 25303

BUSINESS CONFIDENTIAL

September 30, 1986

TO: Mr. J. E. Sanders

COPY TO: Mr. L. C. Calvert
Mr. S. W. Clark
Mr. G. B. Elder
Mr. R. W. Engle

FROM: C. C. Neely

SUBJECT: Final Draft of Recommended C&P Program
Phase-Out Use of Asbestos-Containing Materials in Work Place
Chemicals and Plastic Group

Attached herewith on behalf of the Special Working Group is a copy of the subject document dated 9/29/86. It is a slightly fine-tuned version of the 8/28/86 version which was transmitted to you under my transmittal also dated 8/28/86. The changes that have been made are of a clarifying rather than substantive nature.

At this point, we have not made an effort to obtain broad, formal review of the subject program. However, Larry Calvert has discussed it briefly with the Maintenance APM's and Maintenance Managers. In addition, Stan Clark arranged for its review by the Safety, Health Advisory Committee (SHAC), and your staff has reviewed it. Feedback indicates these groups to be supportive of the concept, but some have expressed concern regarding the January 1, 1989 date specified for the discontinuance of the purchase of asbestos-containing materials, believing it to be optimistic. Some of the concern relates to the following:

1. CED's ability to revise and reissue the V&P Specifications and the Valve Manual in time to support the deadline. The responsible CED specialists have carefully reviewed this matter and believe that reissuance of these Manuals by July 1, 1988 is realistic. This date has not been published, however.



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2. Belief that field testing of new gasket and packing materials will be required. Such testing will not be necessary since the plan at this time is to accommodate most of the substitutions by broadening the use of materials already in use, materials such as reinforced Teflon and GRAFOIL™. This plan has not been broadly disseminated, and we can fully appreciate the reluctance to agree to a purchasing cut-off date for asbestos-containing products without knowing what the substitutes are. We also appreciate that, once this material substitute plan is known, there will be a natural resistance due to the higher first cost of these substitute materials.

3. Some belief that installers will need special training to handle the new gasket and packing materials. For reasons cited in (2), we do not believe this requirement will be significant.

4. Perhaps lack of understanding that the January 1, 1989 date is the cut-off date for the purchase of asbestos-containing materials except as approved by a variance.

5. "Is this really necessary" attitude. The Special Working Group believes that OSHA's recently revised exposure limit of 0.2 fibers per cubic centimeter of air (was previously 2.0 fibers per cubic centimeter) add significant impetus to implement the proposed Recommended Program. According to Terry Hanning's September 5, 1986 memorandum (copy attached), labor union representatives do not believe that controlling the exposure limit to this lower level provides adequate protection.

The above concerns notwithstanding, the Special Working Group decided to submit the subject Recommended Program to you with the January 1, 1989 date included since we believe that, with proper communication with the key plant personnel responsible for its implementation, along with management support, this date is realistic and achievable. We are submitting under separate cover a proposed CED Technology Program which includes request for funds to cover the important communications aspect of the understanding, acceptance and implementation process.

Please let me know how we can be of further assistance regarding this matter.

C. Neely

CCN:mr
4319I
Attachment



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8/28/86

D R A F T

RECOMMENDED POLICY

CHEMICAL AND PLASTICS BUSINESS GROUP (C&P)

SUBJECT: USE OF ASBESTOS-CONTAINING MATERIALS(1) IN THE WORK PLACE

PURPOSE/BACKGROUND

The Corporate Charter (1.1) contains the following commitment to employees:

> "To provide working conditions, programs of training and education, and persistent review and appropriate modification of facilities and practices to protect the health and safety of employees."

It also contains a social commitment to conduct business "in accordance with all the applicable national and local laws and regulations."

As a result of available evidence that airborne asbestos in the occupational environment had proven to be carcinogenic in man, all C&P Insulation Standards were revised in 1976 to specify only asbestos-free insulating materials; and new or replacement installations of these materials have subsequently been selected accordingly. Additionally, a Safety/Health Standard designated SH-256 was prepared covering the safe removal and handling (includes disposal) of asbestos-containing insulating material during renovation and demolition. The requirements of this Standard equal or exceed those of current applicable government standards.

OSHA's rule-making efforts relative to asbestos usage in the work place are mired in controversy. Hearings on the latest EPA proposal which includes the phaseout of all asbestos over a ten-year period are now in progress. The proposal states: "EPA is considering banning the manufacture, importation, and processing of asbestos construction products and asbestos clothing soon after the rule's promulgation with the category of asbestos friction products banned about five years later, and other asbestos products banned at a later time." Gaskets and packing that contain asbestos are in the category of "other asbestos products" that would apparently be banned after ten years. No peer company that we are aware of has a target date for removal of existing asbestos-containing insulation, gaskets, or packing; however, one major chemical company has recently discontinued the purchase of asbestos-containing gaskets and packing.

A cost analysis of pipe-size gaskets shows that GRAFOIL®, probably the most expensive of the acceptable gasket substitute materials, is, in fact, cost effective when only the cost of mandatory work practices associated with the use of asbestos (e.g. wetting for removal or airborne fiber

(1) "Asbestos-containing materials" include but are not limited to insulation, gaskets, packing, welding blankets, and building materials.



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ACL Doc 18894 · Page 9 of 29 asbestosclaims.law/library/18894/9

exposure monitoring during removal, placing in labeled plastic bags after removal, landfill disposal, and record keeping) is considered. The same conclusion is drawn relative to valve packing when the additional considerations of improved service life and sealability are included.

Consistent with the aforementioned commitments and the economic use of materials, C&P has concluded that positive actions relative to asbestos-containing materials(1) should be taken.

POLICY

Except as otherwise provided by applicable law, Chemicals and Plastics Business Group will:

Continue to phase out the use of asbestos-containing materials:

- Asbestos-containing insulation shall be replaced with asbestos-free materials as required to maintain structural and functional integrity.
- No asbestos-containing materials shall be purchased after January 1, 1989.
- C&P approved practices shall be employed for the identification, removal, modification, and/or disposal of asbestos-containing materials.
- Evaluation of asbestos substitute materials shall include consideration of health effects as well as suitability for intended service and cost.
- A variance approval procedure shall be employed to cover consideration of uncommon circumstances. Approval must always include endorsement of C&P HS&EA management.

SCOPE

This recommended policy applies to all C&P operated/hosted facilities. Other components of the Corporation will be apprised of its content.

DELEGATION

The assignment of duties and authority to carry out the policy defined herein is delegated as follows:

To Central Engineering Department

- Develop and maintain engineering standards covering:
  - Identification of asbestos-containing materials;



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- Removal, modification and/or disposal of asbestos-containing materials; and

- Use of asbestos-substitute materials.

To Site Management

- Implement policies and practices for the identification, removal, modification, and disposal of asbestos-containing materials.

- Use of CED Standards covering asbestos substitute materials and the communication of service experience with these materials.

To Manufacturing Services

- Monitor use of asbestos-substitute materials and the communication of service experience with these materials.

To C&P HS&EA

- Audit compliance with governmental regulations and CED-developed standards relating to asbestos-containing materials and, where applicable, their substitutes.

C. C. Neely
2073W



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UNION CARBIDE CORPORATION
SPECIALTY PRODUCTS GROUP

James J. Polomsky
District Sales Mgr.
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(713)+852-9468 (H)

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GRAFOIL®
Flexible Graphite

A Union Carbide Corporation Trademark Product

GRAFOIL® SEMINAR OUTLINE

1. Solving your packing and gasketing problems.
2. Understanding Asbestos packings or gaskets.
3. The search for an asbestos replacement.
4. Current non-asbestos offerings.
5. Characteristics of Graphite.
6. How GRAFOIL® is processed from chrystalline graphite.
7. Characteristics of GRAFOIL® vs. Graphite
8. Chemical resistance of GRAFOIL®.
9. Fire testing and fire safety with GRAFOIL®.
10. Corrosion protection with GRAFOIL®.
11. Oxidation of GRAFOIL® --- Misconceptions????
12. Valves --- Packing Installation procedures and features.
13. Flanges --- Gasketing Installation procedures and features.
14. Gaskets --- GRAFOIL® laminate offering and SWG filler.
15. Product Offerings: Packings, gaskets, ribbons, and tapes.

The seminar includes demonstrations which assist the participant in his/her understanding of the product and lasts about 90 minutes.

NOTE***

Since several of the demonstrations require the use of an open flame, your management is requested to provide a conference room in which these demonstrations may be conducted without violating the safety regulations of your company.



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# GRAFOIL®

Brand Flexible Graphite

Your Seal of Assurance

# Newsletter

Number

PG 008 178

SUBJECT: Special Gasketing Techniques With GRAFOIL® Flexible Graphite

## INTRODUCTION

GRAFOIL® flexible graphite is a resilient form of graphite which has excellent properties as a gasketing material. By itself, GRAFOIL® flexible graphite seals about as readily as rubber. It is also fabricated into metal core laminates or into spiral wound gaskets, and significantly improves their characteristics. In general, GRAFOIL® gaskets will seal the maximum pressure specified on properly designed, correctly manufactured and suitable maintained equipment.

While being flexible and resilient, GRAFOIL® flexible graphite is still all graphite. It has no resins, binders or filler materials or other additives that might detract from the chemical inertness and temperature resistance of pure graphite. GRAFOIL® gaskets will not cold flow, become brittle, or vulcanize to gasketing surfaces in service. The unique chemical and physical properties of GRAFOIL® flexible graphite combine to make it a nearly universal gasketing material especially suitable to high temperature and cryogenic service and/or corrosive environments.

## GENERAL POINTS TO REMEMBER WHEN GASKETING WITH GRAFOIL® FLEXIBLE GRAPHITE

1.) The flange surfaces must be clean, free of nicks, scratches, burrs, metal fillings, scale or other foreign matter.
2.) Use a proper bolt tightening sequence to ensure a uniform load is applied to the joint (see Figure VI). The use of a torque wrench is advantageous to ensure that a uniform tensile stress is applied to each bolt.
3.) GRAFOIL® Grade GHE 316 Stainless Steel Tang Metal Inserted gaskets (Catalog Section G-8817 and G-8819) should not be used between any metal surfaces that are softer than the stainless steel (i.e. aluminum, brass, bronze), or between glass or ceramic surfaces. When GRAFOIL® Grade GHE gaskets are used, the metal tangs must be compressed such that the GRAFOIL® begins to seal. Due to the minimum seating stress recommended for these gaskets (i.e. 2500 psi), the metal tangs can make small indentations in the softer metal of the flange face. The tangs can also create stress concentration points on glass or ceramic surfaces.
4.) GRAFOIL® flexible graphite gaskets must be loaded with a net compressive unit load as shown in the Unit Load vs. Leak Pressure Curve, Figure I, and in GRAFOIL® Catalog Sections G-8816 and G-8817.
5.) The initial thickness of the GRAFOIL® gasket must be such that when it is compressed between two mating surfaces, the GRAFOIL® is strained sufficiently at all points in the joint to seal the maximum service pressure. If the flange surfaces are scratched, serrated, or warped, the initial gasket thickness must be large enough to completely fill and compensate for their effects when the joint is made and the gasket is compressed.

UNION CARBIDE CORPORATION

PO Box 94637 Cleveland Ohio 44101 Telephone (800) 822-4322 in Ohio (216) 529-3900 TELEX 810-421-0047

SP1002 Printed in U.S.A.



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6.) The flatness of the flange surfaces is as essential to good gasketing practice as the proper gasket unit load. If gasketed surfaces are perfectly flat under operating conditions, the average unit load is also the minimum unit load. If, for any reason the gasketed surfaces are not flat while in service, the gasket unit load can be less at some point or points than the amount required to seal operating or test pressures.

In general, if when the flange faces are brought together (i.e. just touching and under no bolt load), a 0.001" feeler gauge can not be inserted anywhere around the circumference of the joint, then a 1|64 inch (0.015") thick GRAFOIL® gasket can always be used. If this criteria can not be met, then the thicker GRAFOIL® gasket will be required.

IMPORTANT POINTS CONCERNING FLANGE SURFACE FINISH AND "STANDARD" SERRATIONS

Under equivalent compressive unit loads, GRAFOIL® gaskets will seal where surface finishes range from 5 RMS (root mean square) to 125 RMS. Within that range any RMS finish will seal as well as any other.

Flanges ordered with "standard serrations" or a "standard finish" usually have finished surfaces machined in accordance with MSS Standard Practice SP-6 (1) which allows for considerable latitude in finish. The SP-6 Standard refers to AARH finishes or arithmetic average roughness. AARH values are different from RMS valves for any given surface. RMS measurements can be made with stylus tracer instruments, whereas, AARH can not. AARH finishes are evaluated only by "sight and touch" comparisons with standard specimens.

The standard serrations may be concentric or spiral. If concentric, there may be up to 32 serrations per inch, and the depth of the serration may range from 0.005" to 0.015". The serration cross-section can range from a radiused "u" cut to a "v" cut.

Flange surfaces having the maximum serrations per inch at maximum depth can leave a "saw tooth" surface with little or no flat areas between the serrations. GRAFOIL® flexible graphite gaskets are not recommended for use with this type of flange finish.

Spiral serrations can range from 20 to 50 per inch in number and from 0.001" to 0.006" in depth. Again, the maximum number of serrations to maximum groove depth can produce a sharp, "saw tooth" surface. However, in contrast with concentric serrations, a spiral serration can form a continuous leak path if the gasket material does not deform and seal all the way to the bottom of the groove. Consequently, the greater the depth of the spiral serration, the greater the required thickness of the GRAFOIL® gasket in order to seal. The required thickness can be calculated in a manner similar to that shown in Case 3.

While serrations, in general, do not help GRAFOIL® gaskets to seal, GRAFOIL® gaskets with their unique physical properties will seal serrations more dependably than most other materials. If a flanged joint is being designed with the intent of using GRAFOIL® flexible graphite gaskets, it is recommended that the serrations and surface finish be dimensioned in detail, rather than left to the broad limits permitted by Standard Practice SP-6.

(1) Developed and approved by the Manufacturer's Standardization Society of the Valve and fittings Industry, 420 Lexington Avenue, New York, New York 10017.



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MAP

RECEIVED
JUN 5 1987
C. P. MAXWELL

UNION CARBIDE

UNION CARBIDE CORPORATION
UNIPOL SYSTEMS/POLYOLEFINS
P. O. BOX 8361, SOUTH CHARLESTON, WV 25303

TO: I. D. Burdett, 511/772
J. W. Flenner, 511/773
D. M. Gaines, 511/773
B. J. Garner, 511/772
H. B. Hinckley, 511/773
G. G. Ransom, 511/770
C. P. Maxwell, 511/701

DATE: June 4, 1987

COPY: F. I. Jacobson, 500, M4
R. H. Smith, 511/701

SUBJECT: RESTRICTED - Safety
Mini-Review
UCC BUSINESS CONFIDENTIAL

You or your designee are invited to a mini-review for the UNIPOL area regarding the testing of the Solvay (titanium trichloride) polypropylene catalyst in our pilot plant. The review will be held on June 10 in the 772 conference room at 1 p.m. All information contained herein is under a secrecy agreement with Solvay and should not be copied or redistributed unless necessary for the purposes of this review.

Pertinent information is attached for your review.

Sincerely yours,

D J Weintritt, Jr.

D. J. Weintritt, Jr.

DJW/blf 3603b
Attachment

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POLYPROPYLENE

SOLVAY CATALYST TESTS

PURPOSE: To test the Solvay XP-12 polypropylene polymerization catalyst in a pilot plant reactor. A C3 homopolymer, C2/C3 random copolymer and a C2/C3 impact copolymer will be made. The catalyst is predominantly titanium trichloride and the cocatalyst is a mixture of diethylaluminum chloride (DEAC) and ethylaluminumdichloride (EADC) as a 20% combined solution in isopentane (will be purchased premixed from Texas Alkyls). Nitrogen will be the carrier gas for the catalyst slurry.We may dilute the alkyl solution some more with isopentane if needed for metering purposes. Reaction conditions will be very similar to current SHAC-103/201 runs, with hydrogen used for molecular weight control and nitrogen for inerting, blowbacks, etc. No unusual operating conditions will be employed and all current standard operating procedures for polypropylene will be followed. Standard polypropylene analytical support will be needed.

HEALTH AND SAFETY: MSDS sheets for the two raw materials are attached.

The catalyst slurry will be handled the same as our SHAC catalysts. The health and safety considerations are the same, though it will react faster to give off more HCl than SHAC. It is not pyrophoric. It can be disposed of via the same procedure as our SHAC catalysts, although we don't intend to throw any of this catalyst away. We will receive the catalyst both in slurry and in dry form. We intend to use the slurry and save the solid for contingencies such as making up more slurry. If this is necessary we can handle these in the drybox the same as we do when making SHAC catalyst slurries.

We have handled DEAC before, and the DEAC/EADC solution will be treated per our normal alkyl handling procedures. There is no unusual health or safety considerations. These materials can be disposed of via the waste alkyls tank per the waste disposal SOP . The DEAC/EADC forms some associative species when combined but we are not doing the mixing and these would not change the safety aspects of handling.

Any unwanted resins which are produced as part of this experimental program can be put to the scrap resin gaylords.

PROCEDURE:

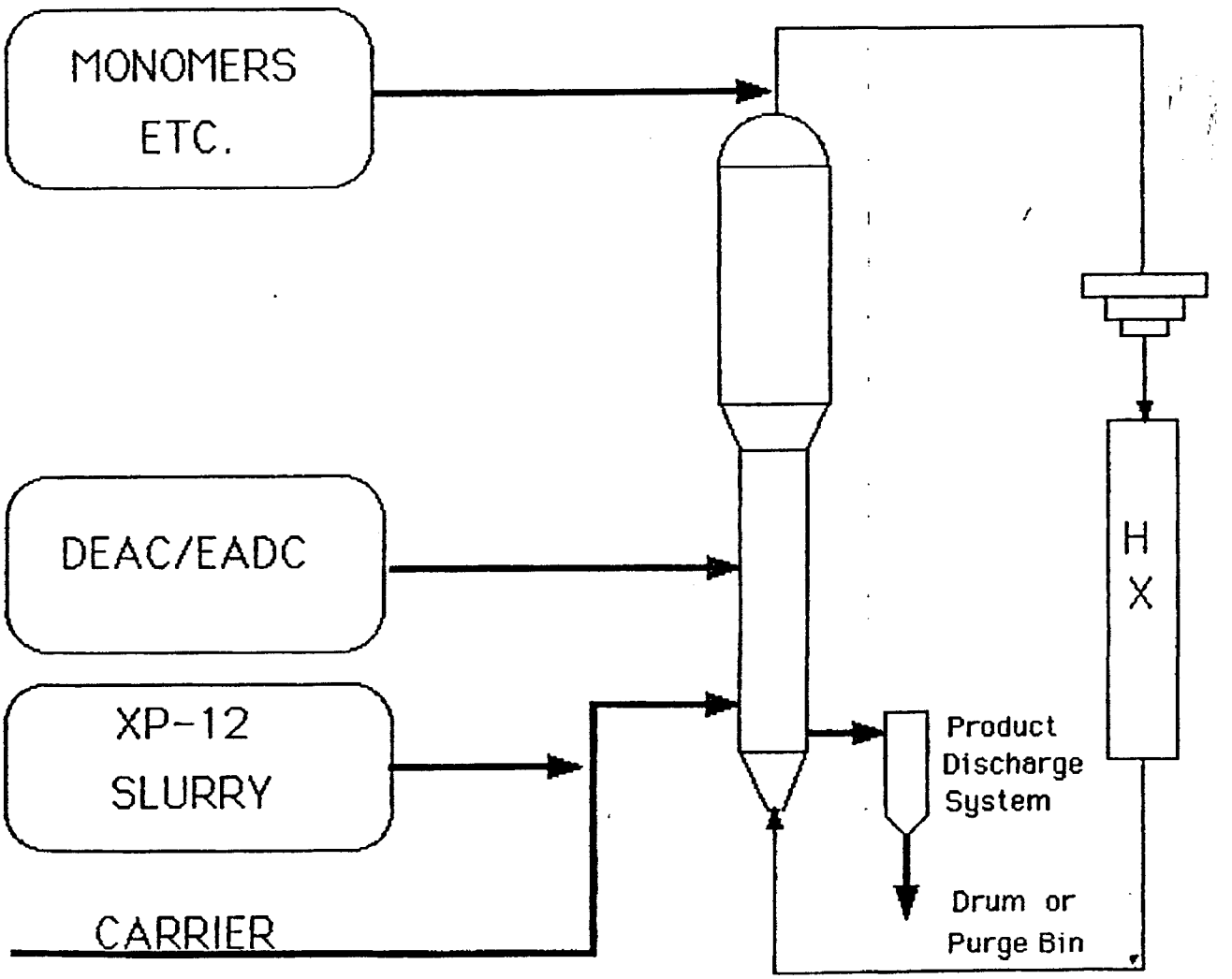
The 3 runs will be made via our standard run plan which gives the process conditions and MSDS sheets. There are no changes in equipment or standard operating procedures. Our slurry feeder and alkyl feed system will be used as is, though the slurry feed rates may be higher.

D. J. Weintritt, Jr. 5/13/87

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# SOLVAY/UNION CARBIDE PROJECT
# UNIPOL POLYPROPYLENE PROCESS
# HOMO/RANDOM OPERATION




CARRIER: Nitrogen

5/13/87

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SOLVAY/UNION CARBIDE PROJECT

IMPACT OPERATION




UCC 0011424


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U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form A
OMB #

# MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

## SECTION I

| MANUFACTURER'S NAME | EMERGENCY TELEPHONE NO |
|---|---|
| SOLVAY-MARGENT CHEMICALS CO., LTD. | Tokyo (03) 282-4104 |

ADDRESS (Number, Street, City, State, and ZIP Code)
6-2 Otemachi 1-chome Chiyoda-ku Tokyo JAPAN

| CHEMICAL NAME AND SYNONYMS | TRADE NAME AND SYNONYMS |
|---|---|
| Titanium Trichloride mixture Non-stoichoric | Solvay PP Catalyst type CA |
| CHEMICAL FAMILY: Inorganic compound | FORMULA: $TiCl_3(AlC_2H_5Cl_2)_{0.1}(C_2H_{11}O$ |

## SECTION II - HAZARDOUS INGREDIENTS

| PAINTS, PRESERVATIVES, & SOLVENTS | % | TLV (Units) | ALLOYS AND METALLIC COATINGS | % |
|---|---|---|---|---|
| PIGMENTS | | | BASE METAL | |
| CATALYST | 100 | | ALLOYS | |
| VEHICLE | | | METALLIC COATINGS | |
| SOLVENTS | | | FILLER METAL PLUS COATING OR CORE FLUX | |
| ADDITIVES | | | OTHERS | |
| OTHERS | | | | |

| HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES | % |
|---|---|
| | |
| | |
| | |
| | |

## SECTION III - PHYSICAL DATA

| | | | |
|---|---|---|---|
| BOILING POINT (°F.) | | SPECIFIC GRAVITY ($H_2O$=1) | 2.0 |
| VAPOR PRESSURE (mm Hg.) | | PERCENT, VOLATILE BY VOLUME (%) | |
| VAPOR DENSITY (AIR=1) | | EVAPORATION RATE (_____ =1) | |
| SOLUBILITY IN WATER | soluble | | |

APPEARANCE AND ODOR: Black - light Purple powder Irritative odor

## SECTION IV - FIRE AND EXPLOSION HAZARD DATA

| FLASH POINT (Method used) | FLAMMABLE LIMITS | LEL |
|---|---|---|

EXTINGUISHING MEDIA: dry chemical powder, vermiculite, dry sand

SPECIAL FIRE FIGHTING PROCEDURES: This compound shall be kept away from water and a because it reacts immediately with these elements.

UNUSUAL FIRE AND EXPLOSION HAZARDS: The above reaction occurs with evolution of gaseous hydrochloride.


(Continued on reverse side)
Form O
Rev 8/7

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Union Carbide trial exhibit UC-4316: Union Carbide Asbestos Removal and Phase-Out Papers, Including T. E. Ha...
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## SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: Hydrochloride : 5 ppm

EFFECTS OF OVEREXPOSURE: The spilled material reacts with moisture and evolve hydrochloride v
may cause bleeding of the nose and gums, ulceration of the nasal and oral muc

EMERGENCY AND FIRST AID PROCEDURES: Eye and skin contact : Immediately flush all af
area with large amount of running water for at least 15 minutes.
Do not attempt to neutralize with chemical agents.

## SECTION VI - REACTIVITY DATA

| | | | |
|---|---|---|---|
| STABILITY | UNSTABLE | No | CONDITIONS TO AVOID: The catalyst should be stor |
| | STABLE | Yes | under 40°C in dry oxygen-free or inert atmos |

INCOMPATABILITY (Materials to avoid): Air, Water

HAZARDOUS DECOMPOSITION PRODUCTS: Hydrochloric acid

| | | | |
|---|---|---|---|
| HAZARDOUS POLYMERIZATION | MAY OCCUR | No | CONDITIONS TO AVOID |
| | WILL NOT OCCUR | Yes | |

## SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: The spilled material shall be co
with non-inflammable sheet to extinguish fire and slow down the reaction rate
with air.

WASTE DISPOSAL METHOD: If large amount of water is available, the catalyst can be
destroyed by dissolve in water gradually.

## SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Cartridge type NIOSH approved respirator.

| | | |
|---|---|---|
| VENTILATION | LOCAL EXHAUST | SPECIAL |
| | MECHANICAL (General) | OTHER |

PROTECTIVE GLOVES: Rubber gloves

EYE PROTECTION: Chemical safety goggles

OTHER PROTECTIVE EQUIPMENT:

## SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: The catalyst should be handled in an
inert atmosphere and kept at cold place to prevent harm catalytic performance

OTHER PRECAUTIONS: Soft handling should be taken for containers



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TEXAS ALKYLS®

# Product Safety Information

## DIETHYLALUMINUM CHLORIDE (DEAC)

This Product Safety Information Sheet is principally directed to managerial, safety, hygiene and medical personnel. The description of physical, chemical and toxicological properties and handling advice is based on past experience. It is intended as a starting point for the development of safety and health procedures.

This sheet gives information only for the pure form of the chemical. Because the product is frequently sold in solution, the physical properties and toxicology of the particular solvent involved should also be considered in developing safety and health procedures.

This product should not be used until personnel handling it have been thoroughly trained. Contact Texas Alkyls, Inc., c/o Stauffer Chemical Company, Specialty Chemical Division, Westport, Connecticut 06881.

### I. PHYSICAL AND CHEMICAL PROPERTIES

Chemical Formula: $(C_2H_5)_2AlCl$
Molecular Weight: 120.56
Physical State: Clear, colorless liquid
Melting Point: −85°C
Boiling Point: 127°C/50 mm Hg
Vapor Pressure: 3 mm Hg @ 60°C
Density: 0.961 g/ml @ 25°C
Viscosity: 1.4 centipoise @ 30°C
Flash Point: Pyrophoric—ignites spontaneously in air

### II. CHEMICAL REACTIVITY

Reacts violently with water, air and compounds containing active hydrogen. Ignites spontaneously on contact with air. Compounds containing oxygen or organic halide may react vigorously with the material.

### III. STABILITY

DEAC is stable when stored under an inert atmosphere and away from heat. Dry nitrogen is a suitable inert gas.

### IV. FIRE HAZARD

Product is spontaneously flammable in air. Pyrophoric by the paper char test* used to gauge pyrophoricity for transportation.

### V. FIREFIGHTING TECHNIQUE

Protecting against fire by strict adherence to safe operating procedures and proper equipment design is the best way to minimize the possibility of fire damage. Immediate action should be taken to confine the fire. All lines and equipment which could contribute to the fire should be shut off. The most effective fire extinguishing agent is dry chemical powder pressurized with nitrogen. Sand, vermiculite or $CO_2$ may be used. *Caution*—reignition may occur.

*DO NOT USE WATER, FOAM, CARBON TETRACHLORIDE OR CHLOROBROMOMETHANE* extinguishing agents as product reacts violently or liberates toxic fumes on contact with these agents.

A standard aluminized firefighting suit is recommended for fighting large aluminum alkyl fires.

Human exposure must be prevented and nonessential personnel evacuated from the immediate area. Breathing vapors from aluminum alkyl fires should be avoided by using proper respiratory equipment. NIOSH-MESA approved air-supplied full face respirator should be used. Combustion of alkyl aluminum halides will result in production of hydrogen halide vapors.

### VI. TOXICOLOGY

**1. Hazardous Combustion Products**

In the presence of air, the compound will combust violently to form aluminum oxide, hydrogen chloride, carbon dioxide, and water. Toxic irritants may result from incomplete combustion.

**2. Ingestion**

Because of the highly reactive nature of this compound with air, ingestion is highly unlikely (See Skin Contact).

In case of suspected DEAC exposure, refer to the procedure in Section VII—FIRST AID. Immediately call, day and night, one of the following emergency contacts:

—Local Physician (Veterinarian, if animal exposure is suspected)
—Nearest Hospital or Poison Control Center
—Texas Alkyls, Inc. (Call Collect) (713) 479-8411
—Stauffer Chemical Company (Call Collect) (203) 226-6602

In case of spillage or contamination of other materials with the product, refer to Section IX—HANDLING SPILLS and call:

—Texas Alkyls, Inc. (Call Collect) (713) 479-8411
—Stauffer Chemical Company (Call Collect) (203) 226-6602
—Chemtrec (800) 424-9300

*Reference: W. L. Mudry, D. C. Burleson, D. B. Malpass, S. C. Watson, *J. Fire and Flammability*, 6, 478 (1975).

All information is offered in good faith, without guarantee or obligation for the accuracy or sufficiency thereof, or the results obtained, and is accepted at user's risk. The uses referred to are for the purpose of illustration only; user should investigate and establish the suitability of such use(s) in every case. Nothing herein shall be construed as a recommendation for uses which infringe valid patents or as extending a license under valid patents

EXCLUSIVE SALES AGENT:
**STAUFFER CHEMICAL COMPANY**
Specialty Chemical Division
Westport, Connecticut 06881
(800) 227-7070

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TEXAS ALKYLS®

# Product Safety Information

## ETHYLALUMINUM DICHLORIDE (EADC)

This Product Safety Information Sheet is principally directed to managerial, safety, hygiene and medical personnel. The description of physical, chemical and toxicological properties and handling advice is based on past experience. It is intended as a starting point for the development of safety and health procedures.

This sheet gives information only for the pure form of the chemical. Because the product is frequently sold in solution, the physical properties and toxicology of the particular solvent involved should also be considered in developing safety and health procedures.

*This product should not be used until personnel* handling it have been thoroughly trained. Contact Texas Alkyls, Inc., c/o Stauffer Chemical Company, Specialty Chemical Division, Westport, Connecticut 06881.

### I. PHYSICAL AND CHEMICAL PROPERTIES

Chemical Formula: $C_2H_5AlCl_2$
Molecular Weight: 126.96
Physical State: Clear, pale yellow liquid
Melting Point: 32°C
Boiling Point: 115°C/50 mm Hg
Vapor Pressure: 5 mm Hg @ 60°C
Density: 1.207 g/ml @ 50°C
Viscosity: 1.6 centipoise @ 50°C
Flash Point: Pyrophoric—ignites spontaneously in air.

### II. CHEMICAL REACTIVITY

Reacts violently with water, air and compounds containing active hydrogen. Ignites spontaneously on contact with air. Compounds containing oxygen or organic halide may react vigorously with the material.

### III. STABILITY

EADC is stable when stored under an inert atmosphere and away from heat. Dry nitrogen is a suitable inert gas.

### IV. FIRE HAZARD

Product is spontaneously flammable in air. Pyrophoric by the paper char test* used to gauge pyrophoricity for transportation.

### V. FIREFIGHTING TECHNIQUE

Protecting against fire by strict adherence to safe operating procedures and proper equipment design is the best way to minimize the possibility of fire damage. Immediate action should be taken to confine the fire. All lines and equipment which could contribute to the *fire should be shut off. The most effective fire* extinguishing agent is dry chemical powder pressurized with nitrogen. Sand, vermiculite or $CO_2$ may be used. *Caution*—reignition may occur.

*DO NOT USE WATER, FOAM, CARBON TETRACHLORIDE OR CHLOROBROMOMETHANE* extinguishing agents as product reacts violently or liberates toxic fumes on contact with these agents.

A standard aluminized firefighting suit is recommended for fighting large aluminum alkyl fires.

Human exposure must be prevented and nonessential personnel evacuated from the immediate area. Breathing vapors from aluminum alkyl fires should be avoided by using proper respiratory equipment. NIOSH-MESA approved air-supplied full face respirator should be used. Combustion of alkyl aluminum halides will result in production of hydrogen halide vapors.

### VI. TOXICOLOGY

**1. Hazardous Combustion Products**
In the presence of air, the compound will combust violently to form aluminum oxide, hydrogen chloride, carbon dioxide, and water. Toxic irritants may result from incomplete combustion.

**2. Ingestion**
Because of the highly reactive nature of this compound with air, ingestion is highly unlikely (See Skin Contact).

In case of suspected EADC exposure, refer to the procedure in Section VII—FIRST AID. Immediately call, day and night, one of the following emergency contacts:

—Local Physician (Veterinarian, if animal exposure is suspected)
—Nearest Hospital or Poison Control Center
—Texas Alkyls, Inc. (Call Collect) (713) 479-8411
—Stauffer Chemical Company (Call Collect) (203) 226-6602

In case of spillage or contamination of other materials with the product, refer to Section IX—HANDLING SPILLS and call:

—Texas Alkyls, Inc. (Call Collect) (713) 479-8411
—Stauffer Chemical Company (Call Collect) (203) 226-6602
—Chemtrec (800) 424-9300

*Reference: W. L. Mudry, D. C. Burleson, D. B. Malpass, S. C. Watson, *J. Fire and Flammability*, 6, 478 (1975).

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TEXAS ALKYLS®

# Product Safety Information

## HYDROCARBON SOLUTIONS OF METAL ALKYLS

This Product Safety Information Sheet is principally directed to managerial, safety, hygiene and medical personnel. The description of physical, chemical and toxicological properties and handling advice is based on past experience. It is intended as a starting point for the development of safety and health procedures.

This sheet gives information only for the hydrocarbon solutions of metal alkyls. For additional information, a Product Safety Information Sheet on the pure form of each metal alkyl is also available from Stauffer Chemical Company. The physical properties and toxicology of both the particular solvent and the metal alkyl involved should be considered in developing safety and health procedures.

These products should not be used until personnel handling them have been thoroughly trained. Contact Texas Alkyls, Inc., c/o Stauffer Chemical Company, Westport, CT 06881.

### I. PHYSICAL AND CHEMICAL PROPERTIES

This group of products is comprised of a variety of metal alkyl hydrocarbon solutions. The following is a list of the hydrocarbon solvents typically used in preparing those solutions: benzene, cyclohexane, heptane, hexane, ISOPAR-E* solvent, ISOPAR-H* solvent, toluene, and xylene.

| | |
|---|---|
| Density | Figure 1 |
| Viscosity | Figure 2 |
| Non-pyrophoric Limit (% Metal Alkyl) | Figure 3 |
| Solvent Vapor Pressure | Figure 3 |
| Solvent Boiling Point | Figure 3 |
| Solvent Flash Point | Figure 3 |

*ISOPAR is a registered trademark of Exxon Corporation.

### II. CHEMICAL REACTIVITY

Solutions may react violently with water, air and compounds containing active hydrogen. These solutions may ignite spontaneously on contact with air. Compounds containing oxygen or organic halide may react vigorously with these materials.

### III. STABILITY

Solutions are stable when stored under an inert atmosphere and away from heat. Dry nitrogen is a suitable inert gas.

### IV. FIRE HAZARD

These solutions are flammable and reactive with air. Solutions are pyrophoric. The degree of pyrophoricity depends upon the hydrocarbon solvent and the percentage of metal alkyl in the solution (see figure 3).

### V. FIREFIGHTING TECHNIQUE

Protecting against fire by strict adherence to safe operating procedures and proper equipment is the best way to minimize the possibility of fire damage. Immediate action should be taken to confine the fire. All lines and equipment which could contribute to the fire should be shut off. *THE MOST EFFECTIVE FIRE EXTINGUISHING AGENT IS DRY CHEMICAL POWDER PRESSURIZED WITH NITROGEN.* Dry sand, vermiculite or $CO_2$ may also be used. *CAUTION-REIGNITION MAY OCCUR.*

*DO NOT USE WATER, FOAM, CARBON TETRACHLORIDE OR CHLOROBROMOMETHANE* extinguishing agents as product either reacts violently or liberates toxic fumes on contact with these agents.

In case of suspected product exposure, refer to the procedure in Section VII—FIRST AID. Immediately call, day or night, one of the following emergency contacts:

—Local Physician (Veterinarian, if animal exposure is suspected)
—Nearest Hospital or Poison Control Center
—Texas Alkyls, Inc. (Call Collect) (713) 479-8411
—Stauffer Chemical Company (Call Collect) (203) 226-6602

In case of spillage or contamination of other materials with the product, refer to Section IX—SPILL HANDLING and call:

—Texas Alkyls, Inc. (Call Collect) (713) 479-8411
—Stauffer Chemical Company (Call Collect) (203) 226-6602
—Chemtrec (800) 424-9300

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(800) 227-7070


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Figure 2. Typical Metal Alkyl/Hydrocarbon Solution Viscosities




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hospital, or the nearest Poison Control Center. Inform the person contacted of the type and extent of exposure, describe the victim's symptoms, and follow the advice given. For additional information, call collect, day or night, Stauffer Chemical Company (203) 226-6602 or Chemtrec (800) 424-9300.

**Ingestion**

Do NOT induce vomiting. Immediately give large quantities of water. If vomiting does occur, give fluids again. Never give anything by mouth to an unconscious person. Call a physician or the nearest Poison Control Center immediately.

**Skin Contact**

Immediately remove contaminated clothing under a safety shower. Flush all affected areas with large amounts of water for at least 15 minutes. Do not attempt to neutralize with chemical agents. If ice is available, apply locally to the affected area. Obtain medical advice immediately.

**Eye Contact**

Immediately flush the eyes with large quantities of running water for a minimum of 15 minutes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eyes and lids with water. Do not attempt to neutralize with chemical agents. Obtain medical attention as soon as possible. Oils or ointments should not be used. Continue the flushing for an additional 15 minutes if the physician is not immediately available.

**Inhalation**

Remove from contaminated atmosphere. If breathing has ceased, clear the victim's airway and start mouth-to-mouth artificial respiration, which may be supplemented by the use of a bag-mask respirator, or a manually-triggered oxygen supply capable of delivering 1 liter/second or more. If the victim is breathing, oxygen may be administered from a demand-type or continuous-flow inhalator, and preferably with a physician's advice. Contact a physician immediately.

## VIII. INDUSTRIAL HYGIENE PRACTICES

**General Practices**

Food should be kept in clean designated areas. Before eating, or consuming beverages, face and hands should be thoroughly washed.

**Ingestion**

All food should be kept in a separate area, away from the working location. Eating, drinking, smoking, and carrying of tobacco products should be prohibited in areas where there is a potential for exposure to the solutions. Before eating, drinking or smoking, in places where it is permitted, persons who have been working with these solutions should thoroughly wash their hands and face.

**Skin Contact**

Skin contact must be avoided through the use of fire retardant clothing. During sampling, disconnecting or connecting lines or opening connections, additional protective outerwear including a full-face shield, impervious gloves, aluminized Nomex coat, a hard hat and chemical safety goggles should also be worn.

**Eye Contact**

During sampling, disconnecting lines or opening connections, chemical safety goggles and a full-face shield should be worn.

**Inhalation**

Solutions should be handled in well-ventilated areas in order to minimize the potential exposure to the solutions or their *combustion products*. Control of these inhalation exposures can be achieved through the use of a cartridge-type, NIOSH-approved respirator.

## IX. SPILL HANDLING

Avoid contact with sources of ignition. Block off source of spill, extinguish fire with extinguishing agent - See Section V. CAUTION - Reignition may occur. If fire cannot be controlled with extinguishing agent, keep a safe distance, protect adjacent property and allow to burn until consumed.

## X. CORROSIVITY TO MATERIALS OF CONSTRUCTION

Under inert conditions, solutions are not corrosive to metals commonly used in construction. Some plastics and elastomers may be attacked. Texas Alkyls, Inc. (713) 479-8411 or Stauffer Chemical Company, Specialty Chemical Division (203) 222-3000 should be contacted for specific recommendations.

## XI. STORAGE REQUIREMENTS

Exercise due caution to prevent damage to or leakage from the container. Solutions should be stored under an inert atmosphere and away from heat. Protect from sources of ignition. See Sections III and X.

## XII. DISPOSAL OF UNUSED MATERIAL

Combustion of the material by controlling feed of air and product is a suitable disposal procedure. The products from complete combustion* are generally carbon dioxide, water, and hydrogen halide (if hydrogen halide is present in the metal alkyl), and the metal oxide. Alternately, disposal can be achieved by diluting the product with hydrocarbon (heptane, etc.) to less than 5 weight percent metal alkyl concentration and treating the hydrocarbon solution with water under a nitrogen atmosphere in a vented and agitated container. Allow for the generation of heat and flammable

*Refer to the Product Safety Information Sheet for the particular metal alkyl under consideration for listings of the specific combustion and hydrolysis products to be released.



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DATE March, 1982

# MATERIAL SAFETY DATA SHEET

("ESSENTIALLY SIMILAR" TO FORM OSHA-20)

WHERE APPLICABLE, THIS PRODUCT HAS BEEN REPORTED FOR THE EPA'S CHEMICAL SUBSTANCE INVENTORY.

## SECTION I - IDENTIFICATION OF PRODUCT

| | |
|---|---|
| MANUFACTURERS NAME: PHILLIPS CHEMICAL COMPANY | EMERGENCY TELEPHONE NUMBERS: DURING BUSINESS HOURS (918) 661-3985; OUTSIDE BUSINESS HOURS (918) 661-8118 |
| ADDRESS (NUMBER, STREET, CITY, STATE, & ZIP CODE): BARTLESVILLE, OK 74004 | PRODUCT NO.: I26500 |
| TRADE NAME: Isopentane | CHEMICAL NAME AND SYNONYMS: 2-Methylbutane |
| CHEMICAL FAMILY: Paraffin | CHEMICAL FORMULA: $(CH_3)_2CHCH_2CH_3$ |

| DOT SHIPPING NAME | HAZARD CLASS | ID NUMBER |
|---|---|---|
| Isopentane | Flammable liquid | UN1265 |

## SECTION II - HAZARDOUS COMPONENTS OF MIXTURES

| INGREDIENTS | CAS NUMBER | % BY WT. | THRESHOLD LIMIT VALUE (UNITS) |
|---|---|---|---|
| Isopentane | 78-78-4 | 100 | |
| | | | |
| | | | |
| | | | |
| | | | |

## SECTION III - TYPICAL PHYSICAL DATA

| | |
|---|---|
| BOILING POINT (°F): 82°F (27.8°C) | APPEARANCE AND ODOR: Colorless liquid with pleasant odor. |
| VAPOR PRESSURE: 20.4 psia (1055 mm Hg) at 100°F | SPECIFIC GRAVITY ($H_2O$ = 1): 0.625 (60/60°F) |
| VAPOR DENSITY (AIR = 1): 2.6 | PERCENT VOLATILE BY VOLUME (%): 100 |
| SOLUBILITY IN WATER: Negligible | EVAPORATION RATE (Ethyl Ether = 1): >1 |

## SECTION IV - FIRE AND EXPLOSION - HAZARD DATA

| FLASH POINT (METHOD) | FLAMMABLE LIMITS (% BY VOLUME) | LEL | UEL |
|---|---|---|---|
| <-60°F (estimated) | | 1.4 | 8.3 |

FIRE EXTINGUISHING MEDIA: Dry chemical, foam, or carbon dioxide ($CO_2$).

SPECIAL FIRE FIGHTING PROCEDURES: Use water spray or fog to cool exposed equipment and containers. Shut off source.

For large fires, or fires in confined areas, self-contained breathing apparatus may be necessary

UNUSUAL FIRE AND EXPLOSION HAZARDS: Highly explosive when exposed to heat or flame within flammable range.

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ACL Doc 18894 · Page 27 of 29
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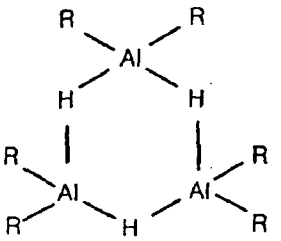
**B. Association**

A common characteristic exhibited by organoaluminum compounds is their tendency to form intermolecularly associated species. This aspect of organoaluminum chemistry has been studied thoroughly[13,41,48,53,60].

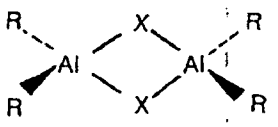
In general, trialkylaluminum compounds exist as dimers associated through electron deficient bonding[61]:

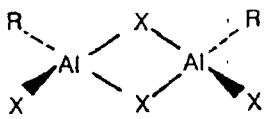


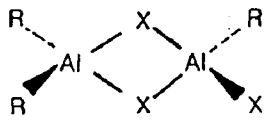
If the alkyl groups possess steric bulk, *e.g.*, isobutyl or neopentyl, the trialkylaluminum compound exists in monomeric form. Dialkylaluminum hydrides are trimerically associated through hydride bridges as below. In contrast to $R_3Al$ compounds, association of



$R_2AlH$ compounds is insensitive to steric requirements of the alkyl groups. Alkylaluminum halides are strongly dimeric, bridging through the halogen atoms as below. An alkylaluminum sesquihalide is essentially a 1:1 complex of $R_2AlX$ and $RAlX_2$ compounds.







Alkylaluminum alkoxides are associated as dimers, trimers or tetramers depending on the nature of the alkyl and alkoxyl groups.

Association in the vapor phase is a property that affects latent heat values. Empirical equations (*Othmer, Clausius-Clapeyron*) are used to estimate $\Delta H_v$ employing molecular weight values of the associated species (see Table 2, page 8).

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