

ARSENIC TRIOXIDE EMERGENCY CONTINGENCY PLAN

AND

INFORMATION GUIDE

WARNING: Aresenic Trioxide is a Class B poison; avoid inhalation and direct contact with the dust.

Emergency Instructions and emergency contacts are contained within this guide.

UN Number 1561
Hazard Class 6.1

06/05/82

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OCCUR

FORWARD

Trimac Transportation System is engaged in the transportation of arsenic trioxide from Giant Yellowknife Mines in the Northwest Territories to CP Rail in Edmonton, Alberta.

Arsenic trioxide is a Class B Poison, and due to its potential hazards, must be transported in the safest manner possible, to prevent exposure to employees and the public, plus prevent contamination of the environment. Should there be a problem enroute, it is essential that the guidelines, as outlined in this Plan, be followed, without exception.

It is impossible to outline, in writing, every given situation that may arise, and therefore any and all incidents or problems must be reported back to the branch, as soon as possible, to ensure the safety and integrity of the product.

All personnel involved directly and indirectly with this product must be fully aware of the hazards of the product and what must be done, should an incident occur.

Prepared by: Barry E. Hedquist
Manager, Loss Prevention
TRIMAC TRANSPORTATION SYSTEM

TRANSPORTATION SPILL ACTION PLAN

FOR ARSENIC TRIOXIDE

I OBJECTIVES:

- Prevent employee exposure to the product.
- Prevent exposure to the public and emergency officials.
- contain the arsenic trioxide and prevent it from contaminating surrounding areas, and particularly waterways.

II EMERGENCY KIT CONTENTS TO BE CARRIED ON EACH UNIT:

- 4 sets of goggles
- 4 disposable uniforms -
- 4 pairs of disposable boots -
- 4 respirators with cartridges -
- 8 sets additional cartridges -
- 4 pairs long gauntlet style rubber gloves-
- large plastic bags with ties
- 2 small shovels
- 1 spill Plan
- 2 rolls aeronautical tape
- 1 roll of 8 mill plastic sheeting X

III EMERGENCY ACTION:

Should an incident arise where there is spillage, the primary efforts must be placed on containment and preventing casual observers and emergency personnel from walking through the contaminated area, or coming in contact with the dust.

When local authorities are contacted, it may be necessary to arrange for a backhoe to get out to the scene so that dirt can be mounded around the spill, and covered with a plastic tarp until clean-up procedures are initiated.

Personnel will wear respirators, tight fitting goggles, gloves, disposable uniforms and disposable boots.

The spill will have to be evaluated on an individual basis, however most dry bulk accidents do not involve catastrophic ruptures of the tank. Small amounts of spillage should be collected in a simple way, that is, by vacuum cleaner, or carefully shoveling the product into open top drums or plastic bags. This material may be placed back into the trailer for processing.

A catastrophic spill may also require the use of a large vacuum truck to transfer the arsenic trioxide into a sift proof trailer with final clean-up conducted either by shoveling dirt into approved containers or possibly through the use of front-end loaders into sift proof dump trucks for transportation to an approved disposal site.

DO NOT use water to flush the site. This action may result in contamination of waterways or municipal water systems.

REPORTING PROCEDURE

Should there be any leakage of arsenic trioxide, or an incident that has or may result in a spill, the driver shall report the problem as follows, in the order shown, using the Emergency Spill Action Plan Report Sheet as a guide.

1. To the nearest police station or emergency centre
2. Contact one of the following, starting from the top of the list:

A. Wayne Peddie, Branch Manager
Business Phone (403) 467-4904
Home Phone (403) 478-0796
Answering Service (403) 467-4904

B. Barry Armstrong, Traffic Supervisor
Business Phone (403) 467-4904
Home Phone (403) 475-5912

C. ~~Dave Garvin~~, Traffic Supervisor
Business Phone (403) 467-4904
~~Home Phone (403) 458-3396~~

D. Gerry Tumbach, Director of Highway Safety
Business Phone (403) 298-5100
Home Phone (403) 271-7431

#. Barry Hedquist, Manager, Loss Prevention
Business Phone (403) 298-5100
Home Phone (403) 248-0456

- II It will be the responsibility of the individual contacted in Section I - 2, to notify the authorities having jurisdiction in the area where the problem has occurred and make the necessary arrangements for clean-up and recovery.
- III One representative from Koppers Company Inc, and one from Giant Yellowknife Mine shall be contacted.
- IV Written reports to the proper authorities will be prepared by the Calgary Head Office, for Trimac Transportation System.

EMERGENCY SPILL ACTION PLAN

REPORT SHEET

Fill Out This Sheet as Soon as Possible

1. Name of Person reporting spill _____
2. Telephone Number _____
3. Company Name _____
4. Company Address _____
5. Chemical Spilled _____
6. Approximate Quantity _____
7. When spill occurred (date & time) _____
8. When spill reported _____
9. Exact spill location _____

- 9a. Injuries and hazards _____

10. Current Situation _____

11. Weather Forecast _____

12. Person Contacted at Trimac _____
13. Person Contacted at Koppers _____
14. Person Contacted at Giant _____
15. Person Contacted at E.P.A. _____
16. Other Officials informed _____

SCHEDULE OF REPORTING REQUIREMENTS
BY TERRITORY AND PROVINCE IN CANADA

I NORTHWEST TERRITORIES:

Mr. D. Billing (Mr. B. Scott)
Environmental Services Division,
Department of Renewable Resources
Government of the Northwest Territories
Yellowknife N.W.T.
X1A 2L9
Phone (403) 873-7354

II PROVINCE OF ALBERTA

1. Alberta Environment (Pollution Control)
24 Hour Emergency Number - 1-800-222-6514
(toll free in Alberta)
2. Mr. Ernie Tyler
Co-ordinator, Alberta Disaster Service
12348 149th Street
Edmonton Alberta
T5V 1B4
Phone: (403) 427-2772
3. Mr. R. Pritchard
Waste Management Branch, Alberta Environment
Oakridge Place, 9820 106th Street
Edmonton Alberta
T5K 1J6
Phone: (403) 427-2739

II 4. Mr. E. Nagy.

Manager, Transport Field Operations

Alberta Transportation

4920 - 51st Street

Red Deer, Alberta

T4N 5Y5

Telephone: (403) 342-6074

United States E.P.A. Regional Oil and Hazardous Materials
Spill Response Telephone Numbers, By Region:

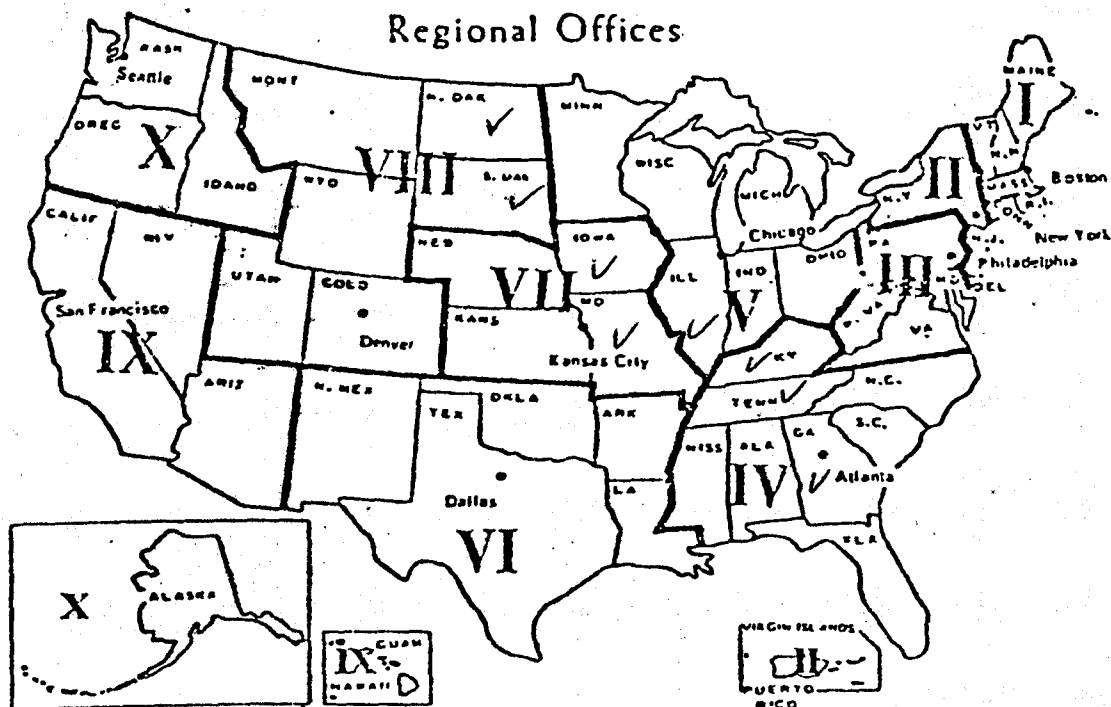
1. North Dakota (303) 837-3880
South Dakota
2. Minnesota
Wisconsin (312) 353-6188
Illinois
Indiana
3. Nebraska
Iowa (816) 374-3778
Kansas
Missouri
4. Kentucky
Tennessee
Mississippi (312) 353-6188
Alabama
Georgia
5. Oklahoma
Arkansas (214) 749-3840
Louisiana
Texas

**EPA REGIONAL OIL & HAZARDOUS MATERIALS
EMERGENCY SPILL RESPONSE TELEPHONE NUMBERS**

REGIONS	TELEPHONE NO.
I	617-223-7265
II	201-548-8730
III	215-597-9898
IV	404-526-5062
V	312-353-6188
VI	214-749-3840
VII	816-374-3778
VIII	303-837-3880
IX	415-556-6254
X	206-442-1200

**UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY**

Regional Offices



REPORTING BY SHIPPER

UNITED STATES

For any spill in the United States, the U.S. Coast Guard National Response Centre must be notified, at the following toll free number:

800 - 424-8802

INFORMATION REQUIRED:

1. Location of spill
2. Chemical spilled
3. Quantity spilled
4. Name and phone number of person reporting the spill
5. Name and phone number of person at the spill site

KOPPERS COMPANY, INC.

1. Koppers Company Transportation,
Emergency Centre (412) 227-2000

	<u>BUSINESS PHONE</u>	<u>HOME PHONE</u>
2. Frank Klosnick, Manager Operations	(404) 363-6300	(404) 979-4773
3. Jim Dunson, Traffic Manager	(404) 363-6300	(404) 366-0418
4. D.F. Marion, Manager, Raw Materials	(412) 227-2775	(412) 367-8765
5. Harris Hollis , Purification Plant Mgr.	(404) 363-6300	(404)
6. Kirk Smith, Plant Supervisor		(404) 627-3675
7. Gerry Robinson		(404) 477-9736
8. Jim Nigell, Chemist		(404) 292-4398
9. <u>Brian Stewart</u>		(404) 292-5522

GIANT YELLOWKNIFE MINES LIMITED

	<u>BUSINESS PHONE</u>	<u>HOME PHONE</u>
1. Kent Morton, Mill Superintendent	(403) 873-6301	(403) 873-2015
2. Harry [unclear] , Assistant Mill Superintendent	(403) 873-6301 <i>Brian Cross</i> <i>mai Contact</i>	(403) 873-2013
3. Ken Blower Mine Manager	(403) 873-6301	

EMERGENCY RESPONSE ASSISTANCE

FOR ARSENIC TRIOXIDE

The following companies have capabilities to provide emergency response in the event of an accidental spill of Arsenic Trioxide. Specific arrangements have not been made on behalf of Koppers to employ their services.

ROGERS PETRO-CHEM WASTE MANAGEMENT

R.R.#1 Grove City, MN 56243

Contact: Mr. DeWayne Rogers (612) 857-2527

Vacuum vehicles are available with emergency response capabilities. Northern sections of area served by subsidiary Bay West. Standard service available within twelve (12) hours driving time of Grove City.

Area: North Dakota, Minnesota, Wisconsin, Illinois, Indiana

INTERSTATE POLLUTION CONTROL, INC.

1525 9th Street, Rockford, Illinois 61108

Contact: Mr. Bill Skoglund (815) 299-1155

Vacuum equipment available for emergency response.

Area: Illinois, Wisconsin

TECHNOSOLVE, INC.

R.R.#1 Box 197A, Zionsville, IN 46077

Contact: Mr. Michael Finton (317) 372-3295

24 hour emergency number (317) 255-3577

Emergency response available for Arsenic compounds.

Area: Illinois, Indiana, Kentucky

ENVIRONMENTAL EMERGENCY SERVICES CO.

Ft. of N. Portsmouth, P.O. Box 3320 Portland Oregon 97208

Contact: Mr. Keith Roberts (503) 285-9111 Ext. 345

emergency hotline (800) 547-0792

Provides emergency response services across U.S.A.

Has 23 systems of personnel and equipment, can operate on a contingency basis. Ability to handle any dry or liquid spill. Used by the Burlington Northern R.R.

Area: Continental U.S.A.

Offices: Fargo, ND; LaCross, WI; St. Louis, MO;
and Monroe, LA.

KANSAS INDUSTRIAL ENVIRONMENTAL SERVICES

P.O. Box 7455 Wichita KS.

Contact: Mr. Cliff McDaniel (316) 744-1286

emergency number (316) 261-9230

All vacuum equipment operates out of Kansas. Past experience with Arsenic Trioxide. Preliminary function is disposal but will respond to spills.

Area: Arkansas, Illinois, Kansas, Missouri

EARTH INDUSTRIAL WASTE MANAGEMENT, INC.

1570 Commerce St., Memphis, TN.

Contact: Mr. Carter Gray (901) 521-0096 (also 24 hour)

No vacuum equipment available, but can handle spill. Has experience with Arsenic Trioxide and can provide response service within three hours driving time of Memphis.

Area: Tennessee and surrounding states

CATALYST SERVICES CANADA LTD.

Box 1050 Cochrane Alberta T0L 0W0

Contact: Mr. Edwards (403) 932-2777 - 24 hour availability
Has equipment available in Calgary, and can respond to spill anywhere given enough response time. Suggests a meeting to discuss requirements for equipment and placement. Has vacuum vehicles operating from Calgary and truck mounted response equipment.

Area: All of Canada and also specific routes in the U.S.
Limitation: driving time

Assuming that Koppers could handle Georgia; only two states do not provide a base for emergency response; Kentucky and Alabama. However, Kentucky is covered by Technosolve, Inc. of Indiana. In speaking with the various firms, Environmental Emergency Services, Rogers Petro-Chem. Waste Mgmt., Kansas Industrial Environmental Services, and Earth Industrial Waste Mgmt., Inc. appear to be most able to provide the services we would require. All companies requested further information prior to any service agreement.

ARSENIC TRIOXIDE DATA SHEETS

AND GENERAL INFORMATION

CHEMICAL SAFETY DATA SHEET

ARSENIC TRIOXIDE

PROPER NAME:

ARSENIC TRIOXIDE

1. PROPERTIES:

A. Physical Properties of Arsenic Trioxide

Molecular Symbol	As ₂ O ₃
Physical State	odourless powder
Colour	white
Melting point	315°C
Specific Gravity	3.43
Solubility	Soluble in glycerine, acids and alkaline solutions; slightly soluble in water.

Chemical Reactivity Contact with acids or acid substances in combination with certain metals for example galvanized sheet or light metal, may cause the formation of toxic fumes. Gas is emitted over 220°C when heated

Flammability

Non-Flammable

2. HEALTH HAZARDS

B. Arsenic Trioxide is poisonous if swallowed or by dust inhalation. Dust may cause irritations on the skin and mucous membranes. Arsenic may cause cancer.

Toxicity - 5Mg/Kg body weight

C. Personal Protective Measures:

1. Avoid direct skin contact by wearing goggles, gloves, disposable boots, and disposal coveralls.
2. Avoid inhalation of the dust by dust respirators.
3. Change work clothes often, wash skin regularly, and avoid smoking where there is a risk of contact with arsenic trioxide.

D. First Aid:

1. If Ingested, cause vomiting by using water, milk or milk of magnesia, and take victim to a physician immediately.
2. If Inhaled, remove victim from the contaminated area, keep breathing passages open, keep him warm and take the victim to a physician immediately.
3. Skin Contact, change clothing and wash powder off with soap and large volumes of water as soon as possible.

E. Emergency Procedures:

Leaks -

1. Personnel required to handle arsenic trioxide shall be trained in the proper actions to be taken in the event of a leak or spill. They shall be instructed to use the proper equipment in the event of an emergency.

- E. 2. If a leak occurs on-route personnel shall:
- i. See that persons not required to deal with the problem are kept clear of the area.
 - ii. Put on suitable personal protective equipment.
 - iii. Tape the leak
 - iv. Shovel up the product, putting it into a plastic bag and placing it inside the trailer.
 - v. Remove protective equipment and put it into a plastic bag and place it in the trailer.
 - vi. Report the incident as soon as possible to the Branch and the proper authorities.
 - vii. Wash thoroughly with soap and water.

Spills -

1. See that persons not required to deal with the emergency are kept well clear of the contaminated area and up wind.
2. Contact the nearest police and emergency departments informing them of the problem as outlined of the Emergency Spill Action Plan Report Sheet.
3. Prevent the arsenic trioxide from contaminating waterways.
4. Large spills should be covered and contained until proper cleanup equipment arrives, by building earthen dikes around the spill and covering with a plastic tarp.

- E. 5. Do Not leave the area unattended until cleanup is completed.
6. Do Not use water to flush the product.

Fire -

1. Keep containers cool by spraying with water. Efforts should be made to contain the water run-off.
2. Toxic gas is emitted over 200°C. Remain up-wind and wear self contained breathing apparatus.

F. Environmental Concerns:

Even small amounts of arsenic trioxide spilled as a result of a leak must be dealt with immediately, to prevent soil and water contamination. Clean up must be completed by removal of any contaminated soil and the area restored to its original state.

If spilled into a waterway, the authorities must be notified as soon as possible, in order to alert anyone using the water from the source of the impending danger.

SAFE HANDLING OF ARSENIC TRIOXIDE

1. TOXICITY

Arsenic trioxide is a poisonous substance, and if taken by mouth, may cause severe illness and death. Suitable precautions must always be taken, to avoid accidental contamination of foods and beverages.

The dust of arsenic trioxide is irritating to the skin and mucous membranes. If dust gets on the skin, especially on skin moist with perspiration and in areas where clothing rubs on the skin, irritation will develop. The skin will become reddened and sore.

If some dust is inhaled repeatedly, a sore spot may develop inside the nose, on the septum - the partition between the nostrils. Or, if dust is inhaled by mouth, there may be irritation of the throat.

Probably because arsenic trioxide dust is irritating, it is unlikely that anyone would ever inhale enough dust to cause poisoning of the whole body like the poisoning caused when arsenic is taken by mouth. At least such poisoning by inhaling dust has not been reported in all the years arsenic trioxide has been used in industry.

2. DUST CONTROL

Mechanical conveying and mixing equipment used for arsenic trioxide should preferably have hoods with powered exhaust ventilation at points of dust dispersion. The decision as to dust control equipment will depend on many local factors and conditions of use and no detailed rules can be stated. In cases where the arsenic trioxide will be used in wet

processes, addition of water to it as early as possible in the production procedures will prevent dust problems. Admixture of a small percentage of a high flash point oil with the dry trioxide, if traces of oil are permissible in the final product, will greatly reduce dusting.

3. PERSONAL PROTECTIVE EQUIPMENT

To keep dust off the skin, long cotton underwear, denim coveralls with attached hood, cotton gloves and high shoes or boots should be worn. The sleeves and legs of the coveralls should be tied around wrists and ankles respectively. Calamine lotion (without phenol) or zinc oxide powder or suitable commercial protective creams afford some protection to the face and other exposed areas of skin. Workmen should have showers after removing their work clothes and before donning their street clothes.

To prevent dust inhalation, masks of sheet wadding in conjunction with the Dr. Wood respirator (American Optical Company) have been successfully used. Used sheet wadding should be replaced with new wadding when the mask is removed at lunch time. Respirators with rubber face pieces rub on the skin and encourage perspiration and skin irritation. The extent of personal protective measures will depend on the amounts of dust to which workmen are exposed and on the length of time of such exposures. Skin and nose irritations, even minor ones are a signal that protective measures are not good enough and that greater care should be taken.

4. FIRST AID AND MEDICAL ATTENTION

In case of accidental swallowing of arsenic trioxide, vomiting should be induced, if possible, and a physician should be called at once.

Irritations of the skin, nose or throat, except for the mildest cases which disappear in a day or two, should have medical attention. Again, such irritations are a warning that preventative measures are not adequate.

5. STORAGE

Arsenic trioxide must be kept out of places where children or animals might get at it. Warning labels and/or signs should always be prominently displayed in storage areas and on containers. Odd unlabeled containers, such as tin cans or buckets, which might later be employed for foodstuffs or drinking water, should not be used.

Arsenic trioxide together with an acid, such as battery acid, and iron or zinc, (a galvanized bucket is zinc-coated) may produce arsine, a highly poisonous gas. This combination of substances is to be avoided.

PRODUCT INFORMATION

Hazards to health and to the environment

PRODUCT

Trade name White Arsenic	Chemical or technical name Arsenic Trioxide
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COMPANY

Information issued by BOL IDEN METALL AB, Snelter, Production group 3 / Alf Björkengren	Date of issue 1978-04-06
Supplier	
Manufacturer BOL IDEN METALL AB, Skelleftehamn, Sweden, Telephone 046-0910-31500	

CLASSIFICATION (according to Swedish legislation)

Product hazardous to health Poison <input checked="" type="checkbox"/> Dangerous substance <input type="checkbox"/> No <input type="checkbox"/>	Subject to registration Reg.nr (Class ①)	No 5:
Classified or considered by Products Control Board/Division Reference schedule <input checked="" type="checkbox"/> Response <input type="checkbox"/> Verdict <input type="checkbox"/> No. in register	No <input type="checkbox"/> Subject to licence Yes <input type="checkbox"/>	No 1:
Inflammable product Class 1 <input type="checkbox"/> 2a <input type="checkbox"/> 2b <input type="checkbox"/> 3 <input type="checkbox"/> Inflammable gas <input type="checkbox"/> No <input type="checkbox"/>	Explosive product Transportation class: A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/>	No 2:
Transportation class according to IMDG (IMCO) 6029 Class 6.1 UN No. 1561	RID (OC7) C1 6.1, 52 ADR (FCE) C1 6.1, 52 RAR (IATA)	

CONTENTS ②

Arsenic trioxide > 99 %

CHEMICAL/PHYSICAL PROPERTIES

General description (form, viscosity, colour, smell etc.)

White powder, odourless

Solubility in water at 20°C: 18,1 g/1000 g H ₂ O at ____ °C:		Solubility in organic solvents (state solvent): Alcohol	
Vapour pressure at 20°C: 8,5 · 10 ⁻¹⁰ mmHg/Pa; at ____ °C: mmHg/Pa		Vapour density (air = 1) ③: -	Evaporation (ether = 1) ③: -
Odour threshold: - ppm	Acidity/Alkalinity: - meq/g	pH in concentrate: -	

Chemical reactivity ⑥: Contact with acids or acid substances in combination with certain metals, for example galvanized sheet or light metal, may cause formation of toxic fumes. Gas is emitted over 200°C when heated.

REMARKS ⑦

Weight by unit of volume: 2 000 kg/m³

INFORMATION ON HEALTH HAZARDS ⑧

Toxicity: < 5 mg/kg body-weight.

Threshold Limit Value: 0.5 mg/m^3 As (Health and Safety Executive (UK) Guidance Note EH 15/76)

Poisonous if swallowed or by dust inhalation. Dust may cause irritations on skin and mucous membranes. The substance may cause efflorescence in longer contact especially with wet skin.

INFORMATION ON ENVIRONMENTAL HAZARDS ⑨

Arsenic trioxide may, in a marine environment, be restored into less poisonous organic arsenical compounds. Arsenic may cause cancer.

PROTECTIVE EQUIPMENT; VENTILATION ETC ⑩

Goggles giving complete protection to eyes.

Suitable respiratory protective device.

Plastic or rubber gloves, plastic or rubber apron. Boots.

See complementary information.

EMERGENCY ACTION (spillage, fire, first aid in case of skin or eye contact, ingestion or inhalation) ⑪

Spillage: Small amounts should be collected in a simple way, e.g. by vacuum cleaner. Large quantities must be handled (shoveled, brushed) by personnel in washable overalls, with rubber boots and gloves, dust respirator and close-fitting goggles. The spillage should be enclosed in a strong, dust-proof packing. **Fire:** Keep containers cool by spray with water. Gas is emitted over 200°C . Don't inhale gas. Use gas-mask working in gas area. **First aid:** If ingested: Cause vomiting by using water, milk or milk of magnesia and take victim to a physician immediately. If inhaled:

Remove victim from contaminated area, keep breathing passages open and keep him warm. If powder on clothes: Change clothes and take a shower with soap.

COMPLEMENTARY INFORMATION ⑫

Sanitary demands

Change working clothes often. Wash the skin regularly. Use talc if needed. Rinse out mouth before smoking or having food. Smoking should not be allowed in places where there is a risk of contact with arsenic trioxide.

Notes

① For pesticides only.

② Primarily components which are of importance for the protection of health and the environment. Quantities should be declared as complete as circumstances allow. In some cases group notations may be acceptable.

③ May be specified as < 1 , $= 1$ or > 1 .

④ Specify if less than 150°C , otherwise specify as $> 150^\circ\text{C}$.

⑤ Specify if less than 100°C , otherwise specify as $> 100^\circ\text{C}$.

⑧ Type and magnitude of risk should be stated as well as acute toxicity, threshold limit value etc. If known also state symptoms of poisoning and the risk of sensitization (allergies). Acute as well as chronic poisoning should be considered. References may be added.

⑨ E.g. degradability, chemical and biological oxygen demand (COD, BOD), toxicity for wildlife and plants, bio-accumulation risks etc. References may be added.

1966

ARSENIC AND ITS INORGANIC COMPOUNDS

This data sheet was prepared by the Industrial Department of the National Safety Council, 425 North Michigan Avenue, Chicago 60611, and is published by the Council.

THIS DATA SHEET is intended to guide employers, plant safety engineers, personnel managers, and supervisors to safe practices in processing and handling all forms of arsenic and its inorganic compounds. A plant engineer who desires additional information should consult a competent industrial hygienist. Such an adviser, if not available within one's own company, may be obtained from an insurance carrier, private consultant, or state health or labor agency.

2. The medical, personnel, and engineering controls described here primarily apply to full-time operations. For intermittent handling of arsenic or its compounds and alloys, modification of these controls may be advisable, depending on the nature, frequency, and duration of the operations.

3. Arsenic and its inorganic compounds fall into three major groups:

- Elemental arsenic.
- Arsenicals, which comprise white arsenic (As_2O_3), the arsenate salts, and the arsenite salts.
- Gaseous arsenic or arsine (AsH_3). Arsenic in the form of arsenic trioxide (As_2O_3) has been known for centuries as an odorless and tasteless poison. Elemental arsenic, however, is seldom responsible for fatal or disabling industrial poisoning. The effects of its fumes and dusts may be cumulative, though, and continued exposure may cause severe symptoms. Arsine, a colorless gas formed when nascent hydrogen is generated in the presence of com-

pounds containing arsenic, is extremely poisonous and can be fatal if inhaled in appreciable quantity. (See paragraphs 50 and 51.)

Properties

4. Although arsenic is stable in dry air, it oxidizes slowly in the presence of moisture to form a greyish mixture of arsenious and arsenic oxides. When heated, it ignites, burns with a bluish flame, and produces dense, garlic-odored fumes of arsenious oxide.

5. The strong inorganic acids vary in their manner of reaction

with arsenic. (a) With strong nitric acid, arsenic undergoes oxidation, ultimately to the pentoxide. This reaction is utilized industrially. (b) Cold dilute sulfuric acid produces no effect, but arsenic is attacked and dissolved by the concentrated acid, with liberation of sulfur dioxide. (c) Hydrochloric acid alone has only a feeble action but, as aqua regia, attacks and dissolves the arsenic.

6. Arsenic reacts directly with the halogens to ignite spontaneously in an atmosphere of chlorine and to combine, when heated, with bromine

Table I

Per Cent Arsenic in Certain of Its Compounds

Compound	Formula	Per Cent
Arsenic trichloride	AsCl_3	42
Arsenic trioxide	As_2O_3	76
Arsenic trisulfide	As_2S_3	61
Arsenic pentoxide	As_2O_5	65
Calcium arsenate	$\text{Ca}_3(\text{AsO}_4)_2$	38
Copper arsenite	CuHAsO_3	40
Lead arsenate	$\text{Pb}_3(\text{AsO}_4)_2$	16.5
Potassium arsenate	KH_2AsO_4	43.5
Copper acetoarsenite	$(\text{CuOAs}_2\text{O}_7)_2 \cdot \text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$	44

The time-weighted average atmospheric concentrations believed safe for continuous exposure during an average work day are based on the per cent arsenic in the compound. This value (called the TLV) is 0.5 milligram of arsenic per cubic meter of air. See paragraph 51.

Physical Properties of Arsenic and important inorganic Compounds

Compound	Formula	Physical State	Color	Melting Point	Boiling Point	Specific Gravity	Solubility
Arsenic (metallic)	As	Brittle, crystalline metal	Silver gray; turns black in air	814 C (1,497 F) @ 35 atmospheres. Sublimes @ 615 C (1,139 F). Appreciably volatile @ 100 C (212 F).		5.6 to 5.9	Soluble in nitric acid; insoluble in water.
Arsenic trichloride Also known as { Arsenic chloride Arsenious chloride Butter of arsenic Caustic arsenic chloride Fuming liquid arsenic	AsCl ₃	Oily liquid	Colorless or pale yellow	-18 C (-0.4 F)	130.5 C (267 F)	2.163	Soluble in concentrated HCl and most organic liquids; decomposed by H ₂ O; fumes in moist air.
Arsenic trioxide Also known as { Arsenious acid White arsenic Arsenious oxide Arsenious arsenic oxide Arsenous anhydride	As ₂ O ₃	Amorphous powder or Vitreous Lumps	White	Sublimes @ 193 C (379 F) Melts 315 C (599 F)		3.730	Soluble in glycerine, acids, and alkalis; slightly soluble in H ₂ O.
Arsenic trisulfide Also known as { Arsenious sulfide Arsenous sulfide Arsenic tersulfide	As ₂ S ₃	Crystals or powder	Yellow; changes to red @ 170 C (338 F)	300 C (572 F)	707 C (1304 F)	3.43	Soluble in HNO ₃ and alkaline solutions; insoluble in H ₂ O and HCl.
Arsenic pentoxide Also known as { Arsenic anhydride	As ₂ O ₅	Amorphous powder	White	Decomposes @ 315 C (599 F)		4.086	Soluble in water, alkalis and ethyl alcohol.
Arsine Also known as { Arsenic hydride Arseniuretted hydrogen	AsH ₃	Gas	None	-113.5 C (-172 F)	-55 C (-67 F)	2.695*	Soluble in H ₂ O; slightly soluble in alcohol and alkalis.
Calcium arsenate	Ca ₃ (AsO ₄) ₂	Amorphous powder	White				Slightly soluble in cold water; insoluble in hot water; soluble in dilute acids.
Copper arsenite Also known as { Cupric arsenite Copper ortho-arsenite Sheele's green.	CuHAsO ₃ or Cu ₃ (AsO ₃) ₂ • 3H ₂ O	Fine powder	Light green	Decomposes			Soluble in acids; insoluble in H ₂ O and alcohol.
Lead arsenate	Pb ₃ (AsO ₄) ₂	Crystalline	White	1,042 C (1,908 F)**		7.30	Soluble in HNO ₃ ; insoluble in H ₂ O.
Potassium arsenate (monobasic)	KH ₂ AsO ₄	Crystals	Colorless or white	288 C (550 F)		2.867	Soluble in water; insoluble in alcohol.
Copper acetoarsenite (CuOAs ₂ O ₃) ₂ • Cu(C ₂ H ₃ O ₂) ₂ Also known as { Cupric acetoarsenite Paris green Schweinfurth green Imperial green King's green Emerald green New green Pat green Moss green Mitis green Vienna green Parrot green		Powder	Emerald green				Soluble in acids; insoluble in alcohol and water.

* Specific gravity with reference to air = 1

** Slightly decomposes at 1,000 C (1,812 F)

with sulfur.

7. Arsenic trioxide is the most important commercial compound of arsenic, and is usually referred to as white arsenic or simply "arsenic." It is an amphoteric compound, its acidic properties predominating. It is soluble both in hydrochloric acid to yield arsenic trichloride, and in alkalis to form arsenites. In water, it is slightly soluble—arsenious acid HAsO_2 being formed. Exposure to oxidizing agents such as ozone, hydrogen peroxide, or nitric acid readily brings about conversion to the pentavalent state; exposure to reducing agents reduce arsenic trioxide to arsenic and arsine.

8. Some of the properties of arsenic and several of its compounds are given in Table II.

Uses

9. Elemental arsenic is utilized in the production of various alloys. It increases the resistance of copper to corrosion, improves its machinability, and raises the annealing temperature.

10. Arsenic trioxide is used in the production of pesticides, such as lead arsenate, calcium arsenate, and copper acetoarsenite (Paris green), and in wood preservatives, such as Wolman salts, which contain 25 per cent sodium arsenate. It is also employed in the manufacture of pharmaceuticals, glass, cattle and sheep dips, hide preservatives, poisoned bait, and weed killers. Arsenicals have been used in the manufacture of dyestuffs, in the production of chemical warfare gases, and as debarking agents in the paper industry.

11. Arsine is employed in the synthesis of organic compounds.

Hazards

12. Occupational poisoning from pure metallic arsenic is rare. Arsenic trioxide taken internally is poisonous and can be fatal, but few cases of general poisoning have occurred from industrial exposure to this chemical. Dermatitis and perforation of the nasal septum are common problems associated with arsenic trioxide, either because of direct contact with the compound in powder form, or exposure to it as air-borne particulate matter.

13. Careful handling and reason-

cient to control dust dispersion in the bagging and handling of non-volatile arsenic compounds. Where arsenic fumes may be present, such as in the sintering and roasting of arsenic-bearing ores, complete enclosure and exhaust ventilation of the operation is needed. If respirators are required for protection against arsenic and its compounds, a respirator approved by the U.S. Bureau of Mines for protection against fumes not significantly more toxic than lead or a similarly approved air line respirator should be used. Handling arsenic trichloride requires complete enclosure because it has a vapor pressure of approximately 11 mm at 25 C, which could result in an air concentration of the order of 14,000 ppm (parts per million).

- Direct contact with the skin must be prevented, particularly contact with the vesicants. Clothing contaminated with dust or liquid must be cleaned before it is worn again.
- Eye protection is needed where arsenicals are handled. Potential dust exposures must be controlled to prevent eye irritation.
- Good washing facilities and appropriate eating and smoking regulations and enforcement of them will prevent the possibility of ingestion.

14. At high temperatures, arsenic and its solid compounds become volatile and produce poisonous fumes. Even though these compounds are noncombustible, their volatility at higher temperatures makes the use of self-contained breathing apparatus mandatory for anyone fighting a fire where they are present.

15. Arsine gas constitutes a serious industrial hazard. In fact, the highest incidence of injury involving arsenic is caused by accidental poisoning from inhalation of arsine, which releases the hemoglobin from the red blood cells and can easily be fatal. Instances of chronic poisoning from arsine have also been recorded. Arsine may be formed when hydrogen is generated in the presence of a material containing arsenic. Consequently, concentrates, intermetallic compounds, and drosses containing arsenic should be handled with care.

- In the smelting and refining industry, impurities in a molten metal

addition of aluminum. Arsenic is one of the more common impurities, along with others such as antimony and sulfur, will combine with the aluminum and concentrate in the dross. Wetting this dross may cause one of several reactions or a combination of them. If nascent hydrogen is released, it could react with even minute amounts of arsenic to form arsine. If aluminum arsenide is formed in the dross, it could react with water to form arsine. These combinations of events have resulted in a number of fatal arsine poisonings.

- The recommended procedure for handling the dross is to convert it to a granular, dusty black form by the addition of sawdust. It is then roasted for at least one hour at 1,800 F, a procedure which effectively stabilizes it to prevent liberation of arsine in the event of future wetting of the dross.
- Certain important industrial metals such as zinc often contain enough arsenic to create a hazardous situation in the presence of an acid. Hydrogen may be produced by the reaction between the zinc and the acid and combine with the arsenic to form arsine. Only a trace of arsenic is required to create a problem. The metallurgical industry is particularly susceptible because acid treatment of arsenic-bearing metals is common.

Containers and shipping regulations

16. Containers and shipping requirements for arsenic and its compounds are specified by Interstate Commerce Commission regulations.* All these compounds are Class B poisons and must carry the poison label. Each container should also carry a printed or stenciled label identifying the contents.

17. Metallic arsenic may be

*Agent T. C. George's Tariff No. 15, Publishing Interstate Commerce Commission Regulations for Transportation of Explosives and Other Dangerous Articles by Land and Water in Rail Freight, Express and Baggage Services and by Motor Vehicle (Highway) and Water, including Specifications for Shipping Containers. Issued by T. C. George, Agent, 63 Vesey St., New York City 10007.



Every employee who handles arsenic or its compounds should wash before eating or smoking. At the end of each workday, he should shower, change his shoes and work clothes. Clothes (including underwear) should be laundered before they are worn again.

shipped in 500-pound barrels or 100-pound casks.

18. Arsenic trichloride may be shipped in 20- or 55-gallon drums or in 5-gallon boxed glass carboys.

19. Arsenic trioxide may be shipped in 5- to 50-gallon drums or in tight wood (oak) barrels of no more than 700-pound gross capacity. Crepe-paper bag liners must be used unless the barrels are constructed with tongue and groove staves. This compound may also be shipped in hopper or bottom-outlet cars equipped with waterproof and dustproof covers. These cars should be used only for delivery to plants with private sidings.

20. Arsine is shipped in steel cylinders; copper arsenite in 1-pound bottles, wood kegs, or fiber drums. Lead arsenate in powder form is shipped in sacks and 100-pound barrels; in paste form, in cases, tins, 100-pound kegs, or 300- and 600-pound barrels.

21. Arsenic trisulfide is shipped in 50-pound multiwall paper bags. Copper acetoarsenite is shipped in 1-pound bottles, wood kegs, or fiber drums.

Storage

22. Arsenic and its compounds should be stored in areas removed from food or food products and from combustible materials. Those capable of sifting should be stored in containers of sift-proof construction. Hoppers and silos made of mild steel are acceptable.

23. Containers that have held arsenic or its compounds should not be cleaned with mineral acids because of the possibility of evolution of arsine.

Handling

24. Arsenic and its compounds require intelligent handling. Employees must be completely familiar with the potentially hazardous nature of such materials. Employee training must include thorough indoctrination in the use of personal protective equipment.

25. The possibility of the formation of arsine should be considered in processes and in areas where arsenic or its compounds are handled. Adequate general ventilation and local exhaust removal must be provided, unless the work is done

plant.

26. Spills of arsenic trioxide or other powdered compounds of arsenic should be removed by a vacuum cleaner with a fabric filter, never by use of a broom. Personnel who empty the vacuum cleaner should be thoroughly trained in handling procedures.

27. General handling precautions that should be followed are:

- Do not permit arsenic or its compounds to come in contact with the skin, eyes, nose, mouth, or clothing.
- Do not eat or smoke in areas where contamination by arsenic or its compounds is possible.
- Wash the hands and face before eating. Wash the hands before smoking. Make every effort to prevent ingestion of or contact with arsenic and its compounds.

Employee training

28. All employees working with arsenic should be trained to work in a hygienic manner. Such training or indoctrination should stress the following points, details of which are covered elsewhere in this data sheet:

- Indoctrination in the toxicity and hazard of inhalation and dermatitis-producing effects of arsenic and its water-soluble compounds.
- Training in safe handling techniques.
- Training on the proper fit, use, and limitations of prescribed respiratory protective equipment.
- Teaching the absolute necessity of assuring that ventilation equipment is in operation at all times when work is being performed.
- Teaching the value of promptness and proper equipment in cleaning up spills. (See "Handling.")
- Explaining the necessity of preventing transfer of arsenic compounds from the plant into the home, which is the basis for clothing changes at each work shift.
- Promoting personal cleanliness depending upon the type of operations involved. Showers may be required. Employees should be encouraged to report all cuts, scratches, or other injuries to supervision so that proper medical attention can be obtained.

... clean work clothes daily, including cotton underwear and socks and a coverall.

30. At the end of each workday, the employee should thoroughly clean his work shoes, take a shower, and make a complete change of clothing. Work clothes should be laundered before they are worn again.

31. Calamine lotion and zinc oxide powder can be used on the hands and other skin areas before work. If gloves made of rubber or other protective material are worn, they must be cleaned inside and out after each use.

32. Local exhaust should be adequate to remove dust or arsine. Dust respirators approved by the U.S. Bureau of Mines should be available for emergency use. If the presence of arsine is suspected, complete respiratory protection approved by the Bureau of Mines for the specific hazard is required.

33. Safety showers and eyewash fountains should be available, and they should be checked frequently to see that they operate properly.

Ventilation

34. Various methods of controlling arsenic dusts and fumes are available. Where possible, an operation should be completely enclosed. This either completely prevents the contaminant from entering the workroom atmosphere or limits to safe levels the amounts that do escape. In addition, this method is generally the least expensive.

35. Many states and municipalities have dust control codes or ordinances with which employers must comply. In a few states, for instance, written approval of plans must be obtained before a local exhaust system is installed. Each employer should therefore know his state and municipal dust control requirements.

36. A local exhaust system for the control of an industrial dust or fume traps the air contaminant near its source so that an operator standing at the process is not exposed to harmful concentrations, if the system cannot be enclosed completely. Local exhaust usually is preferred to general ventilation.

... the air-borne arsenical contaminant is drawn.

b. Ducts, to carry the contaminated air to a central point.

c. Dust and fume collectors, to clean the air before it is discharged.

d. A fan and motor to keep the air moving through the system.

• While each of these parts should be designed and installed to perform its required function with respect to the entire system, design of the exhaust hood demands the greatest care. The degree of control of dust at the point of generation or dispersion is determined by (a) the shape of the hood or degree of enclosure, (b) the location of the hood and its distance from the dust source, and (c) the rate of air-flow into the hood. A poorly designed hood can make an exhaust system ineffective.

37. There is no standard hood design. In every case, the hood must be designed to fit the specific operation and to make the exhaust effective without interfering with the operation. Among the factors to be

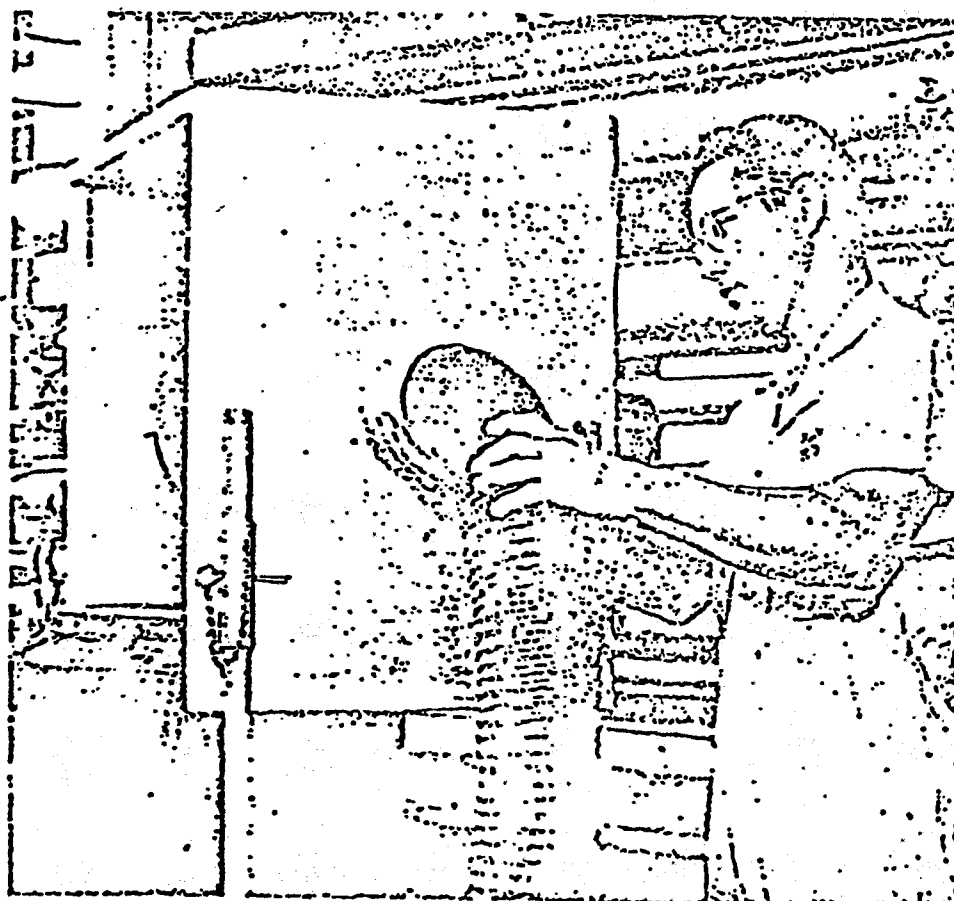
• The hood should be shaped to conform to the shape of the area of dust production so as to secure reasonably uniform air velocity over this area. A hood which does not enclose the process should be placed with its opening as close as possible to the point of generation of the dust or fume because the velocity of the air drops off sharply.

• Air movement must always be past the employee, then over the dust source and directly into the face of the hood.

38. The fan should be of sufficient capacity to maintain the required air capture velocity at the point of generation of the dust. Internal baffles should be installed to guide the air flow where it is most needed. Flanges should be provided wherever possible to reduce the air flow from areas where no dust is produced; that is, air-flow contours should be controlled.

39. When control at the source is not possible, other methods may have to be considered. Any one or a combination of the following types

Portable exhaust hood is used over portable mixer. Air contaminant should be trapped near its source so that those near the process are not exposed to harmful concentrations. If the operation cannot be completely enclosed, local exhaust is next-best method.



limit the exposure.

- The dusty operation may be enclosed, with or without a local exhaust system. An enclosed operation generating large quantities of dust usually needs to be exhausted, or the dust will leak into the surrounding atmosphere.

The dusty work may be performed in a separate building or may be isolated by partitions to reduce the number of employees exposed to the dust. The employees who are still being exposed should be protected by respiratory protective equipment.

- Keeping the materials moist may be a practical means of control.
- General room ventilation can be used to dilute the dust by adding large quantities of air and thus preventing build-up of dust concentrations. Examples of this method are roof fans and roof monitor windows. But it generally is inefficient and expensive to attempt to control contaminants by dilution.
- The dusty work may be performed at night or on week-ends to reduce the number of employees exposed.
- Cleaning dust accumulations from overhead beams, for instance, is preferably done during a weekend.
- The employees who are exposed should use appropriate respiratory protective equipment.

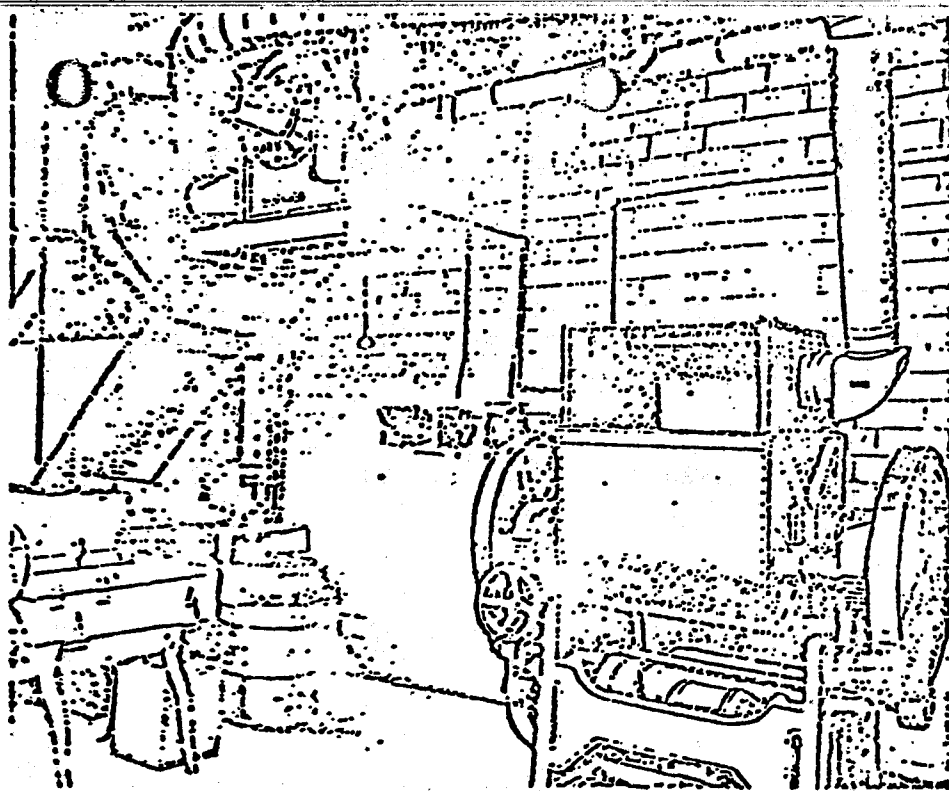
Symptoms of poisoning

40. Employees should be familiar with the symptoms of poisoning and should immediately report to the medical department if these symptoms occur.

41. Symptoms of poisoning by arsine are severe nausea, severe headache, abdominal pain (usually cramps), and numbness and tingling of hands, feet, and face.

42. Some literature on the subject states that arsine can be recognized by its garlic-like odor. However, a number of victims have stated that they smelled nothing unusual at the time of exposure. Those receiving less than the lethal dose usually recover without serious after-effects although permanent injury may occur if exposure has been chronic.

43. Arsenic trioxide, if swallowed in even very small amounts (1 or 2 grains), can cause acute poisoning. Symptoms are severe abdominal pain, difficulty in swallow-



Exhaust hoods over dry mixing machines have flanges to reduce air flow from areas where no dust is produced. Fan should be of sufficient capacity to capture the dust and pull it through the ductwork.

ing, tight feeling in the throat, vomiting, inability to urinate, cold and damp skin, rapid weak pulse, shallow breathing, and sometimes convulsions.

44. Symptoms of poisoning from arsenic trichloride may be intense irritation, itching, or ulceration of the skin and mucous membranes, multiple neuritis (inflammation of the spinal nerves) with sensory and motor disturbances, loss of hair, sweating of palms and soles.

45. Symptoms of poisoning from copper arsenite and copper acetarsenite are similar to those from arsenic poisoning. Lead arsenate has a "double-barreled" effect because both lead and arsenic are highly poisonous (although, individually, arsenic is a more powerful poison than lead). Symptoms of chronic poisoning from lead arsenate are similar to those caused by lead; they include loss of appetite, metallic taste, constipation, severe abdominal cramps, facial pallor, mild jaundice, and anemia.

46. The effects of chronic poisoning by arsenic or arsenic compounds first show themselves on the skin, on the mucous membranes

of the eyes, and upper air passages, in the gastrointestinal tract, and in the nervous system. Often symptoms such as weakness, loss of appetite, and occasional nausea develop slowly, with the eyes, skin, and respiratory system being affected later.

47. Dusts on the skin, especially where there are folds, as around the mouth, or where the surfaces are moist, as in the armpits, set up an eruption or eczematous condition which, if not treated, will lead to extensive ulceration. Inhalation of excessive amounts of dust will lead to perforation of the nasal septum.

First aid

48. If an acute exposure occurs during the handling of vesicant arsenicals, take the victim to a clean area, remove contaminated clothing under a shower, flush exposed skin thoroughly with water, and call a physician.

49. If arsenic or one of its compounds has been swallowed, vomiting should be induced as soon as possible. The victim should be given a glassful of warm water in which a tablespoon of common salt has been dissolved. This remedy should be repeated until the vomited

and accept them while awaiting medical assistance.

50. For a case of acute arsine poisoning, there is no specific first-aid measure other than immediate removal of the victim from the exposure. Medical attention should be secured promptly. A worker exposed to appreciable concentrations of arsine should be hospitalized at once.

Threshold limit values

51. The threshold limit values (TLV)—the time-weighted average atmospheric concentrations believed safe for continuous exposure during a normal work day—established by the American Conference of Governmental Industrial Hygienists are:

Arsenic and compounds, based on the per cent arsenic in the compound (see Table 1).	0.5 Mg/M ³
Arsine	0.05 ppm or 0.2 Mg/M ³
Calcium Arsenate	1.0 Mg/M ³
Lead Arsenate	0.15 Mg/M ³

52. The calculated limit value for arsenic trichloride would be 1.2 mg per cubic meter of air or 0.07 ppm, based on its arsenic content. However, due to the irritant and vesicant nature of arsenic trichloride, it would be advisable to set a limit well below this figure.

Medical examinations

53. Workers who handle arsenic or its compounds should be given thorough preplacement physical examinations and annual examinations thereafter.

54. People subject to chronic or recurrent skin conditions or to intestinal or nervous disorders should not be assigned to jobs in which they may be exposed to arsenic or its compounds. Since these conditions are also symptoms of arsenic poisoning, diagnostic difficulties

may be encountered.

Waste disposal

55. Waste materials containing arsenic or its compounds should be buried in an isolated area. (Check the rules and regulations of the state health department and other regulatory bodies in the particular area involved.) This area should be fenced and restricted. No trespassing or animal grazing is to be allowed. The site selected should be so located that there will be no possibility of arsenic leaching out or being carried by surface drainage to streams, ponds, or private or public water supplies.

56. Combustible containers that have been used for arsenic or its compounds should be burned in small quantities when there is enough wind to disperse fumes. The area downwind from the burning site should be unoccupied for a distance that will allow safe dilution of fumes that may be generated.

REFERENCES

Accident Prevention Manual for Industrial Operations, National Safety Council, 425 North Michigan Avenue, Chicago.

Arsenic and Its Compounds, Ohio State Department of Health, Columbus, Ohio 1940.

Arsenic Trioxide, Chemical Safety Data Sheet SD-60, Manufacturing Chemists' Association Inc., 1825 Connecticut Avenue, NW., Washington, D.C. 1956.

Arsine and Arsenic and Compounds, Hygienic Guide Series, American Industrial Hygiene Association, 14125 Prevoist, Detroit, Mich.

The Condensed Chemical Dictionary, 5th Edition, Reinhold Publishing Corporation, 330 West 42nd Street, New York City.

Dinman, B. D., "Arsenic: Chronic Human Intoxication," *Journal of Occupational Medicine*, 2:137-141 (March 1960).

pany, Baltimore, Md. 1957.

Fleming, A. J., D'Alonzo, C. A., and Zapp, A., *Modern Occupational Medicine*, Lea and Febiger, Philadelphia, Pa. 1954.

Gleason, M. N., Gosselin, R. E., and Hodge, H. C. *Clinical Toxicology of Commercial Products*, The Williams and Wilkins Company, Baltimore, Md. 1963.

Harrison, Joseph W. F., Packman, E. W., and Abbott, D. D., "Acute Oral Toxicity and Chemical and Physical Properties of Arsenic Trioxide," *AMA Archives of Industrial Health*, 17:118-123 (February 1958).

Mayers, M. R., "Occupational Arsenic Poisoning," *AMA Archives of Industrial Hygiene and Occupational Medicine*, 9:384-8 (May 1954).

McKinstry, W. J., and Hicks, J. M., "Emergency: Arsine Poisoning," *AMA Archives of Industrial Health*, 16:32-41 (July 1957).

Morse, K. M., and Setterlind, A. N., "Arsine Poisoning in the Smelting and Refining Industry," *AMA Archives of Industrial Hygiene and Occupational Medicine*, 2:148 (August 1950).

Patty, Frank A., editor, *Industrial Hygiene and Toxicology*, Vol. II, Interscience Publishers, Inc., 215 Fourth Avenue, New York City 1963.

Schrenk, H. H., "Industrial Hygiene Information on Arsenic Trioxide," *Industrial and Engineering Chemistry* (December 1953).

Spolyar, L. W., and Harger, R. N., "Arsine Poisoning," *AMA Archives of Industrial Hygiene and Occupational Medicine*, 1:419 (April 1950).

Vallee, H. L., Ulmer, D. D., and Wacker, W. E. C., "Arsenic Toxicology and Biochemistry," *AMA Archives of Industrial Health*, 21:132-151 (February 1960).

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ARSENIC TRIOXIDE GENERAL INFORMATION

GENERAL DESCRIPTION

White powder, odorless

SOLUBILITY IN WATER

18 grams per liter

CHEMICAL REACTIVITY

Contact with acids or acid substances in combination with certain metals, for example, galvanized sheet metal, may cause formation of toxic fumes. When heated over 200°C gas is emitted.

TOXICITY

Less than 5 mg. per kilogram of body weight

PROTECTIVE EQUIPMENT

Goggles give complete protection to the eyes, suitable respiratory protection, plastic or rubber gloves, plastic or rubber aprons, boots.

EMERGENCY ACTION

Spillage - small amounts should be collected in a simple way, that is by vacuum cleaner. Large quantities must be handled by personnel in protective coveralls with rubber boots, gloves, dust respirator, and close fitting goggles. The spillage should be contained in dust-proof drums or other suitable packing. Fire - keep containers cool by spraying with water, gas is emitted over 200°C, do not inhale the gas. Use gas masks working in gas area.

FIRST AID

If ingested, cause vomiting by using water, milk or milk of magnesia and take victim to a physician immediately. If inhaled, remove victim from the contaminated area, keep breathing passages open and keep him warm. If powder is on his clothes, change clothing and take a shower using soap and water.

SANITARY DEMANDS

Change work clothing often, wash skin regularly, smoking should not be allowed in places where there is a risk of contact with arsenic trioxide.

TRIMAC

ENROUTE SERVICE & SAFETY INSPECTIONS

To be carried out at approximately every 75-100 miles or every two hours. Check stops must be noted on tach card and log sheets.

- A. Hammer check tires - remove debris, i.e. stones, glass, etc. caught in tire treads.
- B. Visual check for oil and coolant leaks.
- C. Visually check all wheel nuts and feel wheel hubs for excessive heat.
- D. Check oil level in sight glasses.
- E. Visually check hose and light cord connections.
- F. Clean lights and licenses when necessary
- G. If operating double units visually check hitch and safety cables.
- H. Make complete visual inspection of equipment, checking for potential leaks, cracks or physical damage. Any signs of leakage, cracking or physical damage to the trailer must be reported to the branch as soon as possible.

Attached as well are:

- 1. Drivers daily equipment report
- 2. Trailer Inspection "A" - 10,000 miles
- 3. Major Trailer Inspection "B" - 50,000 miles
- 4. Tractor Inspection "A" - 10,000 miles
- 5. Tractor Inspection "B" - 50,000 miles
- 6. Tractor Inspection "C" - 100,000 miles

For inclusion in the emergency response contingency plan re:
Arsenic Trioxide.

APPENDIX 'A'

TRAINING REQUIREMENTS

All driving staff involved in the shipping of arsenic trioxide are to be trained at least once each year on the hazards associated with this product; what to do should an emergency occur, plus review of the Arsenic Trioxide Contingency Plan and Information Guide every six months, with a Branch Manager or Driver Trainer, to ensure that they have a thorough understanding of the product and emergency handling procedures.

The yearly training will include the following:

- A. Use of V.T.R. tape on arsenic trioxide.
- B. Instructions on the hazards of arsenic trioxide.
- C. Emergency procedures including leak detection, sealing leaks, how and where to obtain emergency assistance, first aid, product spill containment, and what to do should there be a fire.
- D. Instructions and practical demonstrations on the use of the equipment from the emergency kit are to be completed.

Further to this, all drivers are to be given pre-trip instructions on routing, inspections, emergency contacts, and problem reporting prior to being dispatched.

APPENDIX "B"

ROUTING OF ARSENIC TRIOXIDE UNITS

Any and all units transporting arsenic trioxide are to travel by designated routes only, unless authorization is received from the Branch Manager, to deviate from the routes.

Where possible, the units are to avoid populated areas and stay strictly on truck routes when entering or leaving cities and towns.

Routing and routing changes are to be confirmed prior to dispatch.

APPENDIX 'C'

DISPOSAL OF PRODUCTS SHOULD A SPILL OCCUR

Should a spill occur en-route, where it will be necessary to dispose of any product or other contaminated materials we must first clear any disposal through the authorities having jurisdiction prior to finalizing disposal arrangements.

In Canada, arrangements can be made through Giant Yellowknife Mines for assistance in disposal through the emergency contacts shown in Section VI of this Plan.

Arrangements for disposal in the United States can be set up through Koppers Company Inc., for final disposal in Emelle Alabama.

No product is to be disposed of without prior authorization from head office.