MONSANTO INDUSTRIAL CHEMICALS COMPANY

FUNCTIONAL PRODUCTS GROUP

STANDARD MANUFACTURING PROCESS for AROCLORS (Take-over distilled) Department 246

Supercedes: Standard Manufacturing Process for Aroclors - Department 246, dated October 1966, and all amendments A through L.

Tentative Process for the Continuous Manufacture of Aroclor 1242, dated 9/16/68, and designated Report No. P-1504.

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DEPARTMENT 246 - STANDARD MANUFACTURING PROCESS

AROCLOR

APPENDIX J

SAFETY AND TOXICITY DATA

I. SAFETY EQUIPMENT

A. Fire Extinguishers.

1. Carbon dioxide - 1st floor, NE of lean-to
2. Dry chemical - 1st floor, SE of lean-to
3. Dry chemical - 2nd floor, west wall
4. Dry chemical - 2nd floor, west wall

B. Gas Masks.

1. 1st floor, on sprinkler house
2. 1st floor, outside west wall of repair room
3. 2nd floor, on west wall
4. Control room, east wall
5. 4th floor, on handrail by #1 chlorinator
6. 4th platform, Aroclor column (2)

C. Scott Air Pak.

1. Outside west wall of lean-to

D. Emergency Clothing.

1. Box on 2nd floor, west wall.

E. Safety Showers With Eye Wash.

1. Batch department, 1st floor,
2. Batch department, 2nd floor.
3. Batch department, 3rd floor.
4. Continuous department, 1st floor.
5. Continuous department, 2nd floor.
6. Continuous department, 3rd floor.
7. West side of tank farm (alarm in control room).
8. Control room (eye batch only).

F. Personal Safety Equipment Available.

1. Hard hat.
2. Safety glasses.
3. Safety shoes.
4. Goggles.
5. Rubber or canvas gloves.
6. Rubber overshoes.

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DEPARTMENT 246 - STANDARD MANUFACTURING PROCESS

AROCLOR (Cont'd)

APPENDIX J (Cont'd)

SAFETY AND TOXICITY DATA (Cont'd)

II. DEPARTMENT SAFETY RECORD (246/259).

A. Lost time accidents - Last occurred on January 28, 1948.

B. Serious injuries - The last two serious injuries were:

1) 8/5/70 - See Attached informal investigation report.
2) 12/2/68 - Refer to formal investigation report L-17-20-68.

C. Minor injuries.

Year	Injuries	No. of Men
1969	12	20
1970	12	20
1971	13	24

III. TOXICITY

The following toxic rating code will be used in describing the toxicity of these materials:

0 - none
1 - slight
2 - moderate
3 - high
U - unknown

A. Biphenyl (Code 82601)

1. Synonyms: Diphenyl.
2. Description: White flakes or solid off white mass; somewhat pleasant odor.
3. Constants: Mol. Wt. 154.2; M.P. 69°C.; B.P. 255°C.; Density .9910 @ 75°/4°C.
4. Flash Point: 235° F. (C.C.).
5. Auto Ignition Temperature: 1004°F.
6. Toxic Hazard Rating:
   Acute Local: U
   Acute Systematic: Ingestion 3, Inhalation 3
   Chromic Local: U
7. Fire Hazard: Definitely when exposed to heat or flame; can react with oxidizing materials.
8. Fire Fighting: CO_2 or dry chemical.
9. Formula: $C_6H_5C_6H_5$

DEPARTMENT 246 - STANDARD MANUFACTURING PROCESS

AROCLOR

APPENDIX J (Cont'd)

SAFETY AND TOXICITY DATA (Cont'd)

III.(Cont'd)

A. (Cont'd)

10. Biphenyl vapors are irritating to the upper respiratory tract. Workers should not be exposed to vapor levels throughout their shift in excess of the threshold limit value of 1 milligram per cubic meter of air (or about 0.2 ppm). The compound, or organic solutions of the compound can absorb through the intact skin; therefore, repeated skin contact should be avoided.
11. See Hygienic Guide Series on "Diphenyl".

B. Chlorine (Code 81059).

1. Description: Greenish yellow gas.
2. Formula: Cl_2
3. Constants: Mol. Wt. 70.914; M.P.=101°C.;B.P. - 34.5°C.; Density 1.47 @ 0°C.
4. Toxic Hazard Rating:
   Acute local: Irritant 3; Inhalation 3
   Acute systemic: 0
   Chronic local: U
   Chronic systemic: U
   M.A.C. - 1 PPM in air per 8 hour day

5. Toxicology: Chlorine is extremely irritating to the mucous membranes of the eyes and respiratory tract. It combines with moisture to liberate nascent oxygen and from hydrochloric acid.

   Both of these substances, if present in quantity, cause inflammation of the tissues with which they come in contact If the lung tissues are attacked, pulmonary edema may resul A concentration of 3.5 ppm produces a detectable odor; 15 PPM causes immediate irritation of the throat. Concentrations of 50 PPM are dangerous for even short exposure 1000 PPM may be fatal even when the exposure is brief.

   Because of its intensely irritating properties, severe industrial exposure seldom occurs, as the workman is forced to leave the area before he can be seriously affect In cases where this is impossible, the initial irritation

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DEPARTMENT 246 - STANDARD MANUFACTURING PROCESS

AROCLOR

APPENDIX J (Cont'd)

SAFETY AND TOXICITY DATA (Cont'd)

III. B. 5. (Cont'd)

of the eyes and mucous membranes of the nose and throat is followed by cough, a feeling of suffocation and later pain and a feeling constriction in the chest. If exposure has been severe, pulmonary edema may follow with rales being heard over the chest.

6. Fire Hazard: Moderate - can react to cause fire or explosion upon contact with turpentine, ether, ammonia gas, illuminating gas, hydrocarbons, hydrogen and powdered metals.

7. Explosion Hazard: Present by reaction with reducing agents

8. Disaster Control: Dangerous; emits highly toxic fumes; will react with water to form toxic and corrosive fumes of HCl; is heavier than air - gas will hug the ground. People without adequate protection should go across wind until out of the affected area.

C. HCl Off-Gas (Code 828.51)

1. Synonyms: Muriatic acid, Chlorohydric Acid, Hydrogen Chlor
2. Description: Colorless gas.
3. Formula: HCl.
4. Toxic Hazard Rating:
   Acute local: Irritant 3, Ingestion 3, Inhalation 3
   Acute Systemic: U
   Chronic local: Irritant 2
   Chronic Systemic: U
5. M.A.C.: 5 ppm in air for 8 hr. day.
6. Toxicology: Hydrogen chloride is an irritant to the mucous membranes of the eyes and respiratory tract. Concentration of 35 ppm causes irritation of the throat after short expos Concentrations of 50 to 100 ppm are tolerable for 1 hour. More serious exposures result in pulmonary edema and often laryngeal spasm. Concentrations of 1000 to 2000 ppm are dangerous even for brief exposures. Mists of HCl are considered less harmful than the anhydrous form since the droplets have no dehydrating effect.

7. See Hygienic Guide Series on "Hydrogen Chloride".

DEPARTMENT 246 - STANDARD MANUFACTURING PROCESS

AROCLOR

APPENDIX J (Cont'd)

SAFETY AND TOXICITY DATA (Cont'd)

III. (Cont'd)

D. Ferric Chloride (Code 33500)

1. Description: Granular solid.
2. Formula: $FeCl_3$ (Anhydrous)
3. Constants: Mol. Wgt. = 166.22, Melting Pt.=sublimes, solubility in H_2O = very soluble with heat rise.
4. Toxic Hazard Rating:
   Acute Local: Irritant 1; Ingestion 1
   Acute Systemic: U
   Chronic Local: Irritant 1
   Chronic Systemic: U
5. Fire Hazard: There is no fire hazard under normal condition but it will emit toxic fumes at high temperatures.
6. Handling: Protect the skin with approved protective clothing, avoid the breathing of $FeCl_3$ dust, wear approved respirator with adequate cartridge, and protect the eyes with approved goggles. There are no storage regulations; however, it should be stored in a dry place as heat is released upon solution in water and wet ferric chloride will not catalyze the chlorination reaction.

E. Lime (Code 38800) (Calcium Oxide)

1. Description: Fine white or slightly gray powder, Rhomeric Trigonal crystals.
2. Formula: CaO.
3. Toxic Hazard Rating:
   Acute local: Irritant 3; Ingestion 1; Inhalation 3.
   Acute Systemic: Ingestion 2; Inhalation 3; skin absorption 0.
   Chronic local: Irritant 3; Inhalation 2.
   Chronic Systemic: Ingestion 2; Inhalation 3; Skin absorption 0.
4. Toxicology:
   Has a caustic reaction and, therefore, is irritating to the skin. As a dust it can cause dermatitis and irritation of the eyes and mucous membranes. It is a general nuisance type of dust.
5. Fire Hazard: None.
6. Explosion Hazard: Virtually none.
7. Handling: Dust respirator, adequate protective clothing, including rubber coated gloves, optional rubber full cover apron and full cover plastic goggles should be used when

DEPARTMENT 246 - STANDARD MANUFACTURING PROCESS

AROCLOR

APPENDIX J (Cont'd)

SAFETY AND TOXICITY DATA (Cont'd)

E. 7. (Cont'd)

handling lime (dust). Adequate ventilation and dust removal equipment should be used in the handling area.

Lime is added to the stills to neutralize any liberated HCl a prevent sublimation of the $FeCl_3$ catalyst. It is handled in 50# bags.

F. Nitrogen (Code 43099)

1. Description: Colorless gas
2. Formula: N_2
3. Constants: Mol. Wt. 28.02; M.P. - 210°C; B.P. - 195.8°C.; Density 1.2506 gr/liter at 0°C.
4. Toxicity: None. In high concentrations it is an asphyxiant.

G. Aroclors.

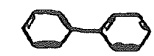
(See Hygienic Guide Series on "Chlorodiphenyls").

Hygienic G...

HYGIENIC GUIDE SERIES

Diphenyl

(Biphenyl, Phenylbenzene)



Significant Physical Properties

Diphenyl is a colorless to light yellow solid with a distinctive aromatic odor.

Molecular weight:	154.20
Flash point:	235°F (113°C) closed cup
Explosive limits:	Lower, 0.6% at 232°F; upper, 5.8% at 311°F
Solubility:	Insoluble in water, slightly soluble in ethanol, soluble in hydrocarbons
Melting point:	70.5°C
Boiling point:	256.1°C
Vapor pressure:[1]	mm Hg 0.001 0.005 0.008 (calc) 0.010 0.0 °C 6.2 20.4 25 27.0 43.5
Odor threshold:[2]	0.06 to 0.29 mg/m³
At 25°C and 760 mm Hg:	Saturated air contains 66 mg/m³ (10.5 ppm) 1 ppm = 0.00631 mg/liter 1 mg/liter = 158 ppm

I. Hygienic Standards

A. RECOMMENDED MAXIMAL ATMOSPHERIC CONCENTRATIONS (8 hours): No formal value has been established. The animal experiments of Deichmann *et al.* have led them to conclude that a concentration of 5 mg per cubic meter should be considered dangerous for continuous exposure.[3]

B. SHORT EXPOSURE TOLERANCE: Not known but moderate air concentrations are irritating and this limits voluntary exposure to levels which are presumably not hazardous.

II. Toxic Properties

A. INHALATION: No cases of acute or chronic intoxication attributed solely to diphenyl have been reported for man in the published literature.[4] Inhalation exposures of ten rats to diphenyl dust impregnated on diatomaceous earth caused irritation of the nasal mucosa, respiratory difficulty with bronchopulmonary lesions, and slight toxic effects in the kidneys and liver at a concentration of 300 mg per cubic meter diphenyl for 64 days, seven hours per day. Five rats died between the 25th and 49th exposure days. The five surviving rats lost weight. Three rabbits exposed under the same conditions showed no evidence of harm. Mice that inhaled 5 mg per cubic meter for 62 days showed signs of respiratory difficulty, but rats at the same concentration showed no evidence of injury.[5]

B. SKIN CONTACT: Repeated application of a 25% solution of diphenyl in olive oil to the clipped skin of rabbits at a

[1] The Committee wishes to acknowledge the assistance of Elmer P. Wheeler and Jack T. Garrett in the writing of this Guide, and of the Industrial Hygiene and Clinical Toxicology Committee of I.M.A. in the preparation of the medical information section of this Guide.

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of splashes from heated diphenyl. An organic vapor mask with full face piece will give protection against splashes and vapors.

4. *Ingestion:* Ingestion of diphenyl is not a problem in industry.
5. *Fire and explosion:* The fire hazard is negligible at room temperature, but is increased at elevated temperatures or when the material is dispersed as fine particles in air.

IV. Medical Information

A. EMERGENCY TREATMENT: Skin surfaces exposed to diphenyl should be thoroughly washed with soap and water at once. If clothing has been contaminated it should be removed promptly.

Particles of diphenyl in the eye should be removed by flushing with water for at least 15 minutes. Splashes of molten diphenyl require prompt medical attention to treat the thermal burn.

Victims of a severe exposure should be removed to fresh air and kept at rest until seen by a physician.

Most persons with acute or chronic irritation of the eyes, skin or respiratory tract recover promptly in fresh air. Occasionally symptomatic therapy is required.

B. SPECIAL PROCEDURES: None indicated.

V. References

1. Technical Note #70, *Vapor Pressures of Organic Compounds in the Range Below 1 mm of Mercury.* National Bureau of Standards. (Oct. 1960).
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3. Deichmann, W. B., K. V. Kitzmiller, M. Dierker, and S. Witherup: Observations on the Effects of Diphenyl, o- and p-Aminodiphenyl, o- and p-Nitrodiphenyl and Dihydroxyoctachlorodiphenyl Upon Experimental Animals. *J. Ind. Hyg. and Toxicol. 29:* 1 (1947).
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14. Bruce, R. B., and J. W. Howard: Colorimetric Determination of Biphenyl in Biological Materials. *Anal. Chem. 28:* 1973 (1956).
15. West, H. D., J. R. Lawrence, I. H. Miller, G. R. Mathura: The Fate of Diphenyl in the Rat. *Arch. Biochem. Biophys. 60:* 14 (1956).
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HYGIENIC GUIDE SERIES

Hydrogen Chloride

I. Hygienic Standards

A. RECOMMENDED MAXIMUM ATMOSPHERIC CONCENTRATION (8 hours): 5 parts per million parts of air, by volume (ppm).[1]
   (1) *Basis for Recommendation:* Sensory response.[1]

B. SEVERITY OF HAZARDS:
   (1) *Health:* Moderate, for acute exposure; low, for chronic. The effects are primarily irritation of upper respiratory passages. Higher concentrations result in eye irritation, and fatal lung injury has been reported from single massive exposures.[4] Erosion of the teeth may occur in persons who work regularly in atmospheres containing hydrogen chloride.
   (2) *Fire:* None.

C. SHORT EXPOSURE TOLERANCE: 50 parts per million parts of air.[2]

D. ATMOSPHERIC CONCENTRATION IMMEDIATELY HAZARDOUS TO LIFE: 1000 to 2000 parts per million parts of air.[2]

II. Significant Properties

Hydrogen chloride is a gas, highly irritating to the nose and throat.

Chemical formula:	HCl
Molecular weight:	36.5
Boiling point:	−83.7° C
Relative vapor density:	1.26 (air = 1)
Solubility:	Water: 82.3 gm per 100 ml of water at 0° C
At 25° C and 760 mm Hg,	
1 ppm of gas:	0.00149 mg/liter
1 mg/liter of gas:	670 ppm

III. Industrial Hygiene Practice

A. RECOGNITION:
   (1) Used chiefly as a water solution (hydrochloric acid) containing 38% or less of hydrogen chloride.
   (2) By its irritant action on the respiratory passages.

B. EVALUATION OF EXPOSURES:
   (1) *Instrumentation:* Collection in water and measurement of electrical conductivity.
   (2) *Chemical:* Collection in water or alkaline solution, and determination of either the acid or the chloride content by acidimetry or titration, respectively. Nephelometry, using silver nitrate, may also be used.[3]

C. RECOMMENDED CONTROL MEASURES: Maintain workroom atmosphere below 5 parts per million parts of air or concentration which causes significant irritation. Protect skin and eyes from contact.

IV. Specific Procedures

A. FIRST AID: If hydrochloric acid is spilled on the skin, the affected part should be immediately flushed with clean water. Eyes, if affected, should be irrigated for at least 15 minutes.

B. SPECIAL MEDICAL PROCEDURES: None.

V. Literature References

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3. HENDERSON, Y. and HAGGARD, H. W.: *Noxious Gases.* Reinhold Publishing Corp., New York (1943).
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Because of space limitations, it is impossible to list all methods of exposure evaluation. The selections have been made on the basis of current usage, reliability, and applicability to the usual industrial type of exposure. Any specific evaluation and/or control problem will involve professional judgment. This can best be done by professional industrial hygiene personnel.

Respiratory protective devices are commercially available. Their use, however, should be confined to emergency or intermittent exposures and not relied upon as primary means of hazard control.

A relative scale is used for rating the severity of hazards: nil, low, moderate, high, and extra hazardous.

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