INDUSTRIAL HYGIENE SURVEY OF THE

Polychlorinated Biphenyl Production Operation
Monsanto Industrial Chemicals Company
Sauget, Illinois

SURVEY DATE

July 21-22, 1976

SURVEY CONDUCTED BY

Mark Jones
Janson Becker

REPORT WRITTEN BY

Mark Jones

DATE OF REPORT

Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

NONS 058418

PLACE VISITED:	Monsanto Company W.G. Krummrich Sauget, Illinois
DATE OF VISIT:	July 21-22, 1976
PEOPLE CONTACTED:	Mr. Art Leisy Manufacturing Superintendent Mr. Paul Heisler ~~Supervisor - Air Pollution~~ Mr. Bruce Eley Corporate Industrial Hygienist Mr. Virgil Brawley Supervisor - PCB Production Mr. John Peduzzi Supervisor - Incineration Mr. Julio Munoz - Air Pollution Group Mr. Neil Sullivan - Air Pollution Group Mr. Frank Basile - Air Pollution Group Mr. Ed ~~Newman~~ - Air Pollution Group Mr. Dale Rachel - Foreman, PCBs Production Mr. Tom Carraco - Foreman, PCBs Production
PERSONS MAKING VISIT:	Mark Jones Janson Becker
PURPOSE:	To conduct an industrial hygiene survey to determine the workers' level of exposure to chemicals present in the polychlorinated biphenyls production area at the Sauget, Illinois facility.

INTRODUCTION

Recent literature has linked polychlorinated biphenyls with possible carcinogenic effects. Because this literature is incomplete, the Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute for Occupational Safety and Health has underway an "industrywide" study of industries using polychlorinated biphenyls. Since Monsanto is the sole producer of polychlorinated biphenyls in the United States, an industrial hygiene survey was conducted at their PCBs production area in Sauget, Illinois, on July 21-22, 1976. This survey was conducted by Janson Becker and Mark Jones.

During the visit, 18 air samples were collected for evaluation of polychlorinated biphenyls exposure. In addition, samples were collected for exposure to iron silica and chlorine.

DESCRIPTION OF THE FACILITY

The polychlorinated biphenyls production operation is one of many operations present at the Monsanto facility in Sauget, Illinois. Sulfuric acid, ~~benzene~~, ~~and~~ benzene derivatives, rubber chemicals (antioxidants, etc.), ~~activated~~ chlorine and phosphorous products are other products produced at the facility.

The facility began production of polychlorinated biphenyls around 1929. Production continued to grow until 1970 when Monsanto began restricting the sale of PCBs ~~for~~ to use in closed systems.

* Benzene is not manufactured at the Sauget Plant.

The entire work force at the facility is approximately 1300 persons, with approximately 835 of these persons being hourly employees. Approximately 25 employees are involved with the production of PCBs. The union representing this group is the International Chemical Workers, Local #12.

MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

A dispensary is located at the plant. Nurses are present at the dispensary 24 hours a day and a physician is present during the day. All employees are required to take a pre-employment physical examination. Certain employees are then required to take periodic physical examinations. Certain employees are required to take additional examinations and special tests.

Industrial hygiene matters at the facility are handled by the Air Environmental Pollution Group. The six people, who are assigned to this group, work in conjunction with the safety department. The only sampling that has been done for polychlorinated biphenyls is the discharge from the area, which is monitored twice a week, and the collection of a few air samples (Appendix B).

Four people work in the safety department. Safety meetings are held every month and safety information is provided to the different work areas through safety committees. Personal protection programs used at the plant include safety shoes, safety glasses, hard hats, protective clothing and respirators (where needed).

Corporate industrial hygienists also give support to the industrial hygiene and safety programs.

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DESCRIPTION OF PROCESS

Three products are made in the PCBs production area: Aroclor 1016, Aroclor 1242, and Aroclor 1254. Aroclor 1016 is used in capacitors and Aroclor 1242 and 1254 are used in transformers. The operation is outdoor and consists mainly of pipeline, reaction vessels, distillation columns and storage tanks. Even though the system is theoretically a closed system, samples are drawn off and leaks occur which give a potential for employee exposure.

Biphenyl is brought to the facility by tank car and pumped to storage tanks. The chlorine used for the operation comes by pipeline from another part of the plant. The chlorine and biphenyl are piped into a chlorinator in the presence of ~~an iron~~ a catalyst and allowed to react. There are two separate groups of chlorinators, one group for producing Aroclor 1254 and the other for Aroclor 1242. The product from the Aroclor 1254 chlorinators goes through a purifying operation which includes a still, receiving tank and filtering system. From this operation the polychlorinated biphenyls go to the appropriate storage tank. The product from the Aroclor 1242 chlorinators goes to an intermediate storage tank and then either through a similar operation as the Aroclor 1254 or to a distillation column ~~which separates the different polychlorinated biphenyl isomers~~ for producing Aroclor 1016. From here it goes to the storage tanks.

The mixing tanks are used to formulate the final product by the introduction of the appropriate additives needed to give the polychlorinated

biphenyls the properties desired by the customer. ~~To give the poly-chlorinated biphenyls better electrical properties a small amount of~~ Diatomaceous earth is used as an aid to filtration ~~added to the blend tanks once a week and then filtered out.~~

INSPECTION OF PLANT

Potential Health Hazards

Potential health hazards observed during this survey were as follows:

1. Polychlorinated biphenyls exposure
2. Chlorine exposure
3. Free silica exposure

Ventilation

Since the operation is outdoors there is very little ventilation. Local exhaust ventilation is used in two operations. The drumming operation is equipped with a hose which is placed near the opening of the 55 gallon drum while it is filled. Near the chlorinators is a work station where employees perform specific tests on samples drawn from the chlorinators. This work station has a hood over the area where the tests are performed.

Housekeeping

Housekeeping in the polychlorinated biphenyls production area was taken care of fairly well. The aisleways were kept clean and clear.

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SURVEY PROCEDURES

General

Air samples were collected in the polychlorinated biphenyls production area for evaluating exposure to polychlorinated biphenyls, iron chloride, and chlorine. A bulk sample of the diatomaceous earth used was analyzed for free silica content. The following paragraphs describe the methods used to collect and analyze the air samples.

Polychlorinated Biphenyls

Both personal and area air samples were collected in the polychlorinated biphenyls production area. Sipin SP1 pumps were used to collect the air samples on florosil tubes. The tubes contain a magnesium silicate absorbent called florosil and have a 100 mg primary section and a 50 mg backup section. Samples were collected for six to eight hours at a flow rate of approximately 200 cc/min. The polychlorinated biphenyls were desorbed from the florosil with hexane and analyzed by using a gas chromatograph with an electron capture detector.

Iron Chloride

Area air samples were collected for iron chloride while the employees poured the iron chloride (powder) ~~cartridges~~ into ~~the reactors~~ 6 reactors. MSA Model G pumps were used to collect the air samples on a 0.8 micrometer pore size mixed cellulose ester filter (37 mm in diameter). Samples were collected for the duration of the task which was approximately three minutes at a flow rate of 1.7 liters per minute. The samples were analyzed for iron by atomic absorption and are reported as such.

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Free Silica

One bulk sample of the diatomaceous earth used was collected for analysis of free silica content. The per cent free silica was determined by x-ray diffraction.

Chlorine

Detector tubes were used to evaluate concentrations of chlorine in the PCBs production area. Chlorine measurements were made using "Bendix Gastec Analyzer Tubes - Low Range (1-8 ppm)."

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RESULTS AND DISCUSSION

Polychlorinated Biphenyls

The results of the area and personal air samples are given in Table 1 and the job descriptions corresponding to the job titles are in Appendix A.

Eleven personal and seven area air samples were collected for analysis for polychlorinated biphenyls. The polychlorinated biphenyls being produced at the time of the survey were for Aroclor 1016 (42% chlorine). The personal air samples ranged from a concentration of 20 $\mu g/m^3$ to 86 $\mu g/m^3$ while the area air samples ranged from 16 $\mu g/m^3$ to 55 $\mu g/m^3$. These are all well below the current standard for chlorodiphenyl (42% of chlorine) of 1 mg/m^3. However, this standard is based upon ~~skin~~ * There have been no instances of any employee experiencing any skin irritation. irritation ~~and~~ Recent literature has (purportedly) linked carcinogenic effects to polychlorinated biphenyls. Therefore, this standard may not adequately protect the workers health.

Iron Chloride

The results of the air samples are given in Table II. Two samples were collected for determining worker exposure to iron chloride. No iron could be detected on one of the samples, but the other sample had an iron concentration of 8.1 mg/m^3. Since this procedure of adding the iron catalyst to the reactor only takes 3 minutes ~~and is done once~~ per shift the workers time weighted average is well below the current standard for iron salts of 1 mg/m^3 based upon soluble iron. The big difference in sample results was probably due to the differences in operating procedures observed each time the task was performed.

* I do not understand this statement. It is my understanding that the "Skin" notation means that the material can enter the body by absorption through the skin by direct contact with the material, NOT that the vapor causes skin irritation at the TLV.

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Free Silica

The bulk sample of diatomaceous earth was analyzed and determined to have a free silica content of 9.8%. Since the procedure of adding diatomaceous earth to the blend tank is done usually only once a week, the survey team was unable to observe this procedure.

Chlorine

No concentrations of chlorine were detected.

CONCLUSIONS AND RECOMMENDATIONS

Based on the observations made during this survey and the results of the air samples, the following conclusions are drawn and recommendations for improvements made:

1) Even though the concentration of iron chloride found during the addition of the catalyst to the reactor is below the Federal Standard, it would be good industrial hygiene practice to continue wearing an approved respirator when this task is performed.

2) Since the diatomaceous earth contains 9.8% free silica, an approved dust respirator should be worn when the worker performs this task if this practice is not presently employed.

3) Because of the recent concern of the possible carcinogenic effects of polychlorinated biphenyls, engineering methods should be used to prevent employee exposure to polychlorinated biphenyls.

4) Emergency equipment (self-contained breathing apparatus) should be readily available in case of a chlorine leak.

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Table I

CONCENTRATIONS OF POLYCHLORINATED BIPHENYL
(detected as Aroclor 1016) IN A FACILITY
MANUFACTURING POLYCHLORINATED BIPHENYLS

Personal Air Samples

Job Title	Date	Total Time (min.)	Volume (liters)	Concentration ($\mu g/m^3$)	TWA ($\mu g/m^3$)
Premium Operator	7/21	436	91.0	47	33
"	7/22	451	97.8	20	
Second Operator	7/21	432	80.0	46	44
"	7/22	448	95.3	43	
Column Operator	7/21		74.9	64	57*
"	7/22	446	85.7	51	
Still Operator	7/21	432	94.6	40	63
"	7/22	444	67.6	86	
Standard Operator	7/22	445	96.1	61	61
Distribution Operator	7/21	413	88.3	54	45
"	7/22	419	91.3	36	

Area Air Samples

Location	Date	Total Time (min.)	Volume (liters)	Concentration ($\mu g/m^3$)	Average ($\mu g/m^3$)
Drumming	7/21	418	89.1	45	48
"	7/22	418	87.6	51	
Temperature Testing	7/21	417	201.6	25	39
"	7/22	455	105.4	52	
Chlorinators	7/21	419	89.0	55	46
"	7/22	459	70.3	36	
Incinerator Burner	7/21	409	81.6	16	16

*Arithmetic Average

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Table II

CONCENTRATIONS OF IRON CHLORIDE
FOUND WHILE OPERATOR ADDED IT AS A CATALYST

Location	Date	Total Time (min.)	Volume (liters)	Concentration of Iron (mg/m^3)	Concentration of Iron Chloride (mg/m^3)
Near Reactor Lid	7/21	3	5.1	N.D.	--
"	7/22	3	5.1	8.1	18.4

Appendix A

JOB DESCRIPTIONS

Premium Operator - Operates both the continuous and batch chlorinators. This includes keeping the chlorinators running, adding ~~the~~ iron chloride ~~catalyst once a shift~~ end drawing samples ~~off twice a shift~~.

Second Operator - Loads the tank cars for shipment and takes care of the tank farm and blend tanks.

Standard Operator - In charge of making sure area is clean and does all the filling of the 55 gallon drums.

Column Operator - Operates the distillation column used to produce Aroclor 1016.

Still Operator - Operates both stills used in producing Arolcor 1254 and 1242.

Distribution Operator - Works in a different area of the plant and is in charge of operating the incinerator.

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Appendix B

CONCENTRATION IN THE ATMOSPHERE IN THE
MANUFACTURING DEPARTMENT BATTERY LIMITS AS MEASURED IN OCTOBER, 1975

Date	Location	mg/m^3
10/ 9/75	12 ft. operating level at batch chlorinator	0.022
10/ 9/75	12 ft. operating level at continuous chlorinator	0.012
10/13/75	12 ft. operating level at batch chlorinator	0.057
10/13/75	12 ft. operating level at continuous chlorinator	0.058
10/14/75	Ground floor operating level	0.006
10/16/75	Ground floor, scrubber discharge area	0.338

SOURCE: Monsanto

Proposed Revision to ANSI C-107.1(1972)

1. SCOPE

This standard establishes guidelines for the safe transport, use, maintenance, and disposal of askarel and askarel-soaked material used in capacitors and transformers.

2. GENERAL INFORMATION

2.1 General. The term "askarel" generally describes a broad class of nonflammable synthetic chlorinated hydrocarbon insulating liquids widely used in capacitors, transformers, reactors, and accessory equipment operated at power frequencies.

Askarels consisting of or containing polychlorinated biphenyls (PCBs) have been used in many applications since the early 1930's, but only recently was it discovered that PCBs are widely dispersed in the environment. Systematic investigations of the biological effects of PCBs have been undertaken within the past few years to establish the effects of specific formulations on specific species. Studies have shown that PCBs are an environmental contaminant. Significant steps have been taken by U.S. industry to limit further releases of PCBs to the environment.

PCBs have been used in three broad types of applications as follows:

(1) "Open-ended" applications; for example, in paints, speciality inks, paper coatings, plastics, etc.

(2) "Nominally closed" applications; for example, as the working fluid in hydraulic and heat transfer systems.

(3) "Closed electrical system" applications, specifically as the insulating fluid in certain kinds of transformers and capacitors.

Effective January 15, 1972, the Monsanto Company, sole domestic producer of PCBs discontinued supplying PCBs to all except manufacturers of electrical transformers and capacitors.

Evaluations of the benefits, risks, and alternatives involved in the continued use of PCBs in closed electrical systems are summarized in 2.2 through 2.4.

2.2 Benefits. Askarel-filled transformers are used where fire-resistant properties are important. Askarel-filled power and industrial capacitors are significantly smaller, more reliable, more durable, and safer than oil-filled capacitors. As a result, askarels have supplanted mineral oils in more than 90% of the power and industrial capacitors made today. Over the past few decades most of the equipment that incorporates such capacitors has been designed to take particular advantage of the size, safety, and reliability benefits of askarel capacitors (for example, many types are today less than 14% of the size of equivalent oil capacitors and have a life expectancy of 10 to more than 20 years).

Various federal, state, and local codes dictate the present use of askarel-containing equipment in or adjacent to public, commercial, and industrial buildings, which locations present the greatest potential danger to life and property.

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2.3 Health. In the United States, medical records since the early 1930's show that the only adverse health effects experienced by U.S. workers exposed to askarels, either during the manufacture of these liquids or of electrical equipment containing these liquids, have been limited to occasional cases of monochronic chloracne or other temporary skin lesions or irritations.

Askarel-filled transformers and capacitors are delivered to customers as sealed units from which there is no escape of askarel under normal operation. Although certain types of equipment failures can result in loss of some askarel to the environment, transformer failures are limited to approximately 0.02% of the units in service per year. With respect to capacitors, such losses are limited to approximately 0.04% of the units in service per year. In addition, limited amounts of PCBs can get into the environment during the manufacture, delivery, improper use, maintenance, repair, and disposal of transformers and capacitors.

Specific control measures have been instituted by individual manufacturers and users and are supplemented and strengthened by national standards and procedures such as this standard, which provides information to prevent the inadvertent loss of PCBs to the environment at all stages from initial askarel manufacture through ultimate disposal.

2.4 Alternatives. For technical and local and national code reasons, it would be impossible to replace most askarel-filled transformers now in service with oil-filled units of equivalent ratings without major construction changes that would be required to compensate for the fire resistance of the askarel-filled units. For certain applications and locations, dry-type transformers may replace askarel-filled transformers.

For new installations, although many of the foregoing limitations would still apply, building and installation design provisions could be made to accommodate the use of oil-filled, open dry-type or sealed dry-type transformers, provided that necessary technical, code, physical size, and cost considerations are properly evaluated.

Several potential alternative transformer fluids are under intensive investigation to determine if they will have satisfactory electrical and operating performance charactoristics. Such liquids must be acceptable environmentally, to the users, and from the fire risk standpoint.

The principal alternatives to askarels for capacitors are either mineral oil or various types of synthetic fluids. The latter types are under intensive investigation by the industry. Mineral oil and these newer fluids are flammable. The use of mineral oil would return capacitor technology to its pre-1932 level and would necessitate the redesign and replacement of such widely used equipment as flourescent light fixtures and racks for power and induction-heating capacitors, which could not now accommodate the increased size of oil capacitors while maintaining their present ratings. For the newer types of synthetic fluids under investigation it must be determined if they will yield satisfactory operating performance, are environmentally acceptable and that liquid non-flammability is not required.

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Long before there were any environmental concerns about PCBs, there was a strong economic incentive to find other less expensive insulating liquids with the desirable characteristics of askarels. Omitting economic considerations there are no technically equivalent fluids available today.

3. CAPACITOR GUIDELINES

3.1 General. The environmental effects of askarels are under in-depth study by governmental and other agencies. Askarels have been considered relatively harmless to humans based on safe industrial usage, since the 1930's, except for minor skin and eye irritation. There have been no known instance of human injuries when they were used under the normally accepted precautions and conditions of handling in both manufacturing and user applications.

Askarels are being found in the environment and in fish and bird life. The long-term genetic and ecological effects are not yet completely understood. For these reasons, care should be taken to contain askarels and minimize their entry into the environment.

There are two general classes of askarels used by the electrical industry. The higher chlorinated grades are the more persistent in nature. Because of their higher degree of resistance to burning, they are used in transformers where personnel safety is of paramount importance.

Capacitor-grade askarel has a lower degree of chlorination (composed primarily of the 3-chlorine isomers of biphenyl) and a higher degree of biodegradability. Generally, it has not been found in animal life. It is used in capacitors, where the extreme resistance to burning required in transformers is of less importance.

Although capacitor-and transformer-grade askarels both contain members of the PCB family, they do differ in composition, degree of biodegradability, persistance in nature, electrical stability, chemical stability, and degree of flammability (both are recognized as highly resistant to burning. It is for those reasons that Section 3 of this standard is intended to apply to capacitor-grade askarel.

3.2 Capacitor Grade Askarel. In September 1971, a new grade of capacitor impregnant, Aroclor 1016, was made available to the industry. This new grade contains a typical concentration of 0.4% or less by weight of the higher boiling homologues of the chlorinated biphenyls. [See ASTMD3303 -74(2)[1]] Aroclor 1016 replaces Aroclor 1242, which previously was the major capacitor impregnant and contained around 7% of the higher-boiling homologues (the more persistent in nature). This 0.4% level of the higher-boiling homologues should be the maximum concentration acceptable in any capacitor impregnant. Aroclor 1242 and 1254, previously used as impregnants, do not meet this requirement and should no longer be used in capacitors designed and manufactured for alternating-current applications.

Aroclor 1016 has the same Underwriters' Laboratories, Inc. flammability rating as Aroclor 1242.

Commonly used solvents for clean-up purposes, include benzene, kerosene, acetone, trichloroethane, trichloroethylene, and perchloroethylene. Typical vapor pressure data for Aroclor 1016 are:

0°C	=	0.001	mmHG
25°C	=	0.006	mmHG
150°C	=	4.3	mmHG
200°C	=	29.0	mmHG

At 25°C and 760 mmHG pressure, saturated air contains approximately 0.09 mg/l.

NOTE: 1 mg/l = 90.0 ppm (v/v)
1 ppm (v/v) = 0.011 mg/l

[1] Numbers in brackets refer to corresponding numbers in 7.1, References to the Text.

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3.3 Employee Safety and Plant Housekeeping. The procedures and limits given in 3.3 are intended to be minimum requirements to be met by manufacturers and users of capacitors containing askarel. Handling, control, and disposal procedures are given, together with exposure limits and indicated antidotes and clean-up procedures.

3.3.1 General Safety Precautions. Although it is generally accepted that exposure to capacitor-grade askarel is not hazardous provided that simple precautions are taken, exposure should still be avoided.

3.3.1.1. Vapors. The odor of askarel is noticeable well below the maximum air concentrations considered safe. Up to 1.0 milligram per cubic metre of air has been determined to be the maximum safe level of exposure during an 8-hour workday. (See reference 19)

The procedure for performing the necessary analyses of vapors is referenced in Section B3 of Appendix B. This procedure or its equivalent should be used.

Breathing vapor or fumes from heated askarel should be avoided. Provisions should be made for adequate ventilation and regulation of manufacturing operations to avoid open exposure to askarel (especially at temperatures of 55°C or higher). The gases produced when askarel is decomposed by very high temperatures (such as that of an electric arc) in the presence of air or organic insulating materials contain a very high percentage of hydrogen chloride, and small percentages of carbon dioxide, carbon monoxide, and oxygen. Minute concentrations of this combination of gases are very unpleasant and irritating, thus giving ample warning of their presence. If exposure to high concentrations of askarel is necessary under emergency conditions, an approved gas mask or self-contained breathing apparatus should be worn. Such exposure should be under the surveillance of other personnel capable of effecting rescue in case of an accident. If the odor of askarel is detected by the person wearing protective equipment, he should immediately go into fresh air. All gas masks, respirators, and replacement parts should have U.S. Bureau of Mines approval and be maintained on a regular schedule in accordance with the manufacturer's recommendation.

3.3.1.2 Liquid. In contrast to the situation in which mineral insulating oils are handled, there is virtually no fire hazard in handling askarel. A limited solvent action (similar to that for paint thinner) on the fats and oils of the skin with prolonged contact may lead to drying and chapping of the skin. As with insulating oil, some people are allergic to askarel, and continued exposure may result in skin irritation. Both the liquid and vapor are moderately irritating to eye tissue.

Operating procedures should be such as to minimize or eliminate contact with askarels. The use of porous gloves that can absorb and retain askarel is to be avoided. Resistant gloves[2] should be used if contact is unavoidable. Use of enclosed transfer and handling equipment, processing equipment, and mechanical washers reduces direct contact.

2 For example, Edmont-Solvit 5-352 (Mersick of Bridgeport, Bridgeport, Conn), or the equivalent.

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Medicinal washes or mild detergents followed by the application of cold cream will reduce the irritation resulting from the contact of an open cut or abrasion with askarel.

Safety glasses with side shields or a face shield should be worn when handling askarels. If liquid askarel contacts the eyes, the eyes should be irrigated immediately with large quantities of running water for approximately 15 minutes and then examined by a physician (A drop of (U.S.P.) castor oil has been found to reduce irritation).

Persons developing a skin irritation or respiratory tract irritation while working with askarels should be placed under the supervision of a physician. Ingestion or swallowing of askarels is not generally regarded as a problem of the industry; However, should accidental ingestion occur, a physician should be consulted.

Hands should be cleaned of askarel before eating, drinking, smoking, or using toilet facilities by means of waterless hand cleaners[3] and wipe towels which should then be properly disposed of.

3.3.2 Bulk Fluid Shipment Receiving and Transfer. Shipment of askarel from point of manufacturing to point of receiving should be done in closed containers such as rail tank cars, truck tanks, marine or barge tanks, or sealed drums. In case of an askarel spill during bulk fluid shipment, reference should be made to paragraph 6.0 which provides procedures for control and listed authorities to be notified. Containers should be labeled as to contents and carry a label cautioning against loss of fluid to the open environment (See section 3.6). Containers used to transport askarel should not be used for storage or to transport other material without being completely cleaned of all traces of askarel. (Cleaning procedures must take cognizance of precautions against excessive exposure and of the need for proper disposal of contaminated cleansing solvents and materials as set forth in 3.5) Transfer from shipping containers to processing systems should be through closed piping or tubing with appropriate valves, pumps, etc. Provision should be made for trapping and disposing of fluid lost by leakage or spills from the transfer system and from the storage containers.

Drums to be retired from use should be cleaned before crushing, delivery to scrap dealers, or other disposal. Contaminated cleaning fluids and materials should be disposed of as indicated in 3.5.

3.3.3 Manufacturing Housekeeping. Manufacturing equipment and operating procedures should safeguard against loss of askarels to the environment through proper containment and disposal procedures.

3.3.3.1 Processing Area Control. Enclosed systems of sealed piping, properly gasketed joints, valves, containers, and processing chambers should be used for all operations where askarel temperatures may exceed 55°C. Enclosure should preferably extend to all other portions of the system insofar as practicable.

Establish containment methods and/or procedures for all askarel processing areas to prevent loss to sewer systems by spillage, leakage or other uncontrolled conditions or events.

[3] For example, Pow'r Kleen Handcleaner, (Woodbine Chemical and Research, Inc., Medina, Ohio or Man's Hands, Oak Industries, Inc., Moosick Falls, New York)

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3.3.3.2 Types and Control of Liquid Askarel Wastes. Askarel-containing liquid wastes may occur in manufacturing from sources such as the following: 1) Liquid askarel contaminated during processing which is unsuitable for reclaiming as a dielectric fluid, 2) liquid askarel from solvent operations or water and detergent type washers, 3) vacuum pump oils contaminated with askarel, 4) steam jet vacuum system condensates contaminated with askarels, and 5) askarel containing materials from laboratory samples.

Waste fluids containing askarel should be collected (by means of traps, drip pans, trays, etc) and disposal should be in accordance with 3.5.

Spills of askarels should be contained and cleaned up promptly by means of absorptive material, such as sawdust, or trapped and removed by pumping or other suitable means. Disposal should be per 3.5.

3.3.3.3 Types and Control of Other Askarel Containing Wastes. Saturation of materials with askarels may occur in manufacturing from the following sources: 1) Saturated earth or other absorbant media from filtering operations or from cleaning up spills, 2) saturated filters from vapor control devices and other filters, 3) saturated wastes such as paper, rags, etc. 4) saturated spent gasket materials and 5) capacitors failing tests or otherwise designated for disposal.

All of the above items should be collected for proper disposal. Wiper rags, protective clothing[4] and other extraneous materials which are likely to be soiled should preferably be made of disposable materials. Other materials should be collected within the containment area for properly controlled laundering.

3.4 Control of Plant Effluents.

3.4.1 Water Effluents. The industry goal is to eliminate askarel in plant water effluent streams. However, it is recognized that existing drain systems in capacitor manufacturing plants are probably contaminated as a result of past practices, and askarel traces may continue to decrease with the proper containment of askarel wastes and no further discharges into drain systems. Other sections of this standard provide that no askarel wastes of any kind be disposed of in any water effluent streams and that accidental spills be prevented from getting into such streams.

3.4.1.2 Concentration Limits. The EPA has proposed water quality criteria to maintain PCB concentration in rivers and lakes below detection level. Requirements under Sections 307(a), 307(b) and 311 of the 1972 Amendments to the Federal Water Pollution Control Act are under review (1976-77) and the latest revisions will apply. State and municipal requirements must also be met.

Further information may be obtained from an Environmental Protection Agency Regional Office. A listing of these offices is contained in Appendix D.

3.4.1.3 Monitoring Streams. On a regular basis consistent with plant situations, all effluent streams should be analyzed. The procedure for performing the necessary analyses is per ASTM Method D3304. This procedure or its equivalent should be used.

[4] For example, Edmont-Wilson, 1294 Walnut St., Coshocton, Ohio 43812, or Sloaman Corp., P.O. Box 3014, Asheville, N.C. 28802

3.4.1.4 Methods for Minimizing Effluent Stream Contamination. The ideal approach is to isolate totally all effluents that could be contaminated with askarels during manufacturing processes and prevent them from being discharged from the plant. Carbon absorption, limestone beds, and solvent extraction are techniques that could be applied to reduce the askarel content of effluent streams. These techniques may be most useful in cleaning up water used in plant processing and to permit recycling.

3.4.2 Air Effluents. The industry goal is to eliminate askarel vapors in plant air effluents. Plant operations involving askarels at elevated temperatures in excess of 55°C should be performed, wherever possible, within closed systems. Filtration of plant air effluents, to minimize PCBs entry into the environment, should be accomplished where envolvement of air borne PCBs may occur from open operations.

3.4.2.1 Monitoring. All plant air effluents should be sampled and analyzed on a routine basis consistent with plant situations. The procedure for performing the analysis is per ASTM Method D3304 (See Appendix B3).

3.5 Scrap-Disposal Procedures. The manufacture and use of capacitors involves processes which produce askarel-saturated solids and liquids containing or composed entirely of askarel, which should be disposed of as wastes. Specific sources of these materials are described throughout this standard. They may be placed into three categories:

1) Capacitor units impregnated with askarel, production and field rejects
2) Manufacturing process liquid wastes containing askarel
3) Solid waste purposely or accidentally saturated with askarel

Disposal should be done in a manner which is consistent with proper concern for the environment and minimizes any release of askarels to the environment.

3.5.1 Disposal of Capacitor Units. Scrap capacitor units can be generated during manufacturing processes or during field service. Production rejects are those capacitors that are rejected after the impregnation process in the course of production by the capacitor manufacturer. They may be rejected for mechanical or electrical reasons.

Field rejects are those units that are rejected or, for other reasons, are to be scrapped after shipment from the plant where they were manufactured.

Capacitor units should be disposed of intact, or if leaking, in sealed drums. The small amount of liquid to be drained, the integrity of intact units and the necessity for complex control over drainage procedures make intact disposal preferable.

3.5.1.1 Production Rejects. Rejected capacitors in capacitor manufacturing plants represent a concentration of askarel. It is, therefore, important that disposition be made in a manner consistent with proper concern for the environment. Preference should be given to disposal of capacitors in sites approved for hazardous waste disposal (See Appendix A). Another alternative, but less desirable, would be disposal in approved landfill sites.

Care should be exercised to insure that no loss of liquid will occur during transportation to the disposal site.

Incineration of scrap capacitors in facilities designed to accept such solids would provide a preferential alternative to approved landfill sites when such services become available.

3.5.1.1 Field Removal. Wherever practical, all askarel containing capacitors should be removed prior to disposal of equipment. This precaution will enhance environmental control procedures and insure that by removing these capacitors they do not ultimately disperse their askarel contents into an unapproved landfill site.

After removal from equipment, capacitors should be disposed in accordance with the procedures for production rejects (3.5.1.1). Where removal of askarel-containing capacitors from equipment is not practical, that equipment should be disposed of only in approved landfill sites.

3.5.2 Disposal of Liquid Wastes. All waste askarel or liquid wastes containing askarel should be disposed of in accordance with one of the procedures given in 3.5.2.1 or 3.5.2.2. However, preference should be given incineration, 3.5.2.1.

3.5.2.1 Incineration. Proper incineration must involve a suitable balance between dwell time and temperature in the incinerator plus oxygen availability, and finally, suitable scrubbers to remove the HCL that will be formed; for example, 2-second dwell time at 2000°F and 3% excess oxygen in stack gas, or 1.5 second dwell time at 2700°F and 2% excess oxygen in stack gas.

These facilities should meet the applicable state requirements and should control effluents within the limits set forth in this standard.

3.5.2.2 Chemical Waste Disposal. Where incineration is not feasible, sites which have been classified by state agencies as suitable for disposal of chemical waste liquids should be used (See Appendix A).

3.5.3 Disposal of Solid Wastes (See 3.5.1 for scrap capacitors). All solid wastes which have been saturated with askarel should be placed in leak proof containers and preferably transported for disposal by incineration. A less preferable disposal procedure is an approved landfill site. See Appendix A for listing of Facilities.

3.5.4 Packaging and Shipment.

3.5.4.1 Transportation to the disposal facility should be in containers that will prevent leakage and accidental loss of askarel to the environment.

3.5.4.2 Containers should be labeled as to contents and precautions relative to loss to the environment per 3.3.2.

3.5.4.3 Containers for this purpose cannot be used for any other materials or they should be retired from service until they are completely cleaned. Any solvents used in cleaning these containers will be contaminated with askarel and should be disposed of according to the same procedures described in 3.5.2.

3.6 Labeling. Capacitor units vary greatly in size and in end use or application. Small capacitor units are frequently applied as a component of another piece of equipment, such as a fluorescent lighting ballast, a roadway of area lighting luminaire, a motor, etc. In such applications a label on the capacitor unit referencing approved disposal procedure would not normally be visible when the piece of equipment is disposed of.

For the foregoing reasons the methods of labeling for small capacitors and large capacitors are treated separately in 3.6.1 and 3.6.2, respectively.

3.6.1 Small Units. Small capacitors are defined as those that contain askarel in quantities up to about 2 pounds each and in which the free liquid does not exceed 0.4 pounds. They are hermetically sealed in metalic cases. It is recommended that shipping containers from capacitor manufacturers should be labeled as to contents and that transporters be given instructions, in accordance with paragraph 6.12 as to procedures in the event of a spill.

If, however, a label of the capacitor is required by statute or by specific manufacturers, the following is suggested:

Contains PCBs. Use care in disposal.

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The shipping container label, yellow on black, should contain the following information:

"CAUTION" Contains PCBs (Polychlorinated Biphenyls) that are environmental contaminants. In case of leaks or spills, restrain discharge and consult manufacturer. In transportation emergencies, call National Response Center (800-424-8802) and Chemtrec (800-424-9300). Avoid prolonged breathing of vapors or mists, contact with eyes or skin. Disposal should be in accordance with NIOSH C-107 Guidelines or applicable State and Federal statutes."

Small unit capacitors are applied as a component of a large piece of equipment. Manufacturers utilizing askarel-filled capacitors should affix a label referencing this standard or describing disposal procedures consistent with it.

3.6.2 Large Units. Large capacitor units are defined as those which contain more than 2 pounds of askarel. The manufacturer should affix a label in a conspicuous place on the capacitor, referencing this standard or describing disposal procedures consistent with it. As a minimum, the label should contain information listed in 3.6.1.

3.7 Information for Users of Large Capacitors

3.7.1 General. Large Askarel-filled capacitors contain more than 2 pounds of askarel and delivered to customers as sealed units from which there is no escape of askarel under normal operation. Although certain types of equipment failures can permit loss of some askarel to the environment, such cases are extremely rare.

3.7.2 Transportation and Receiving. Immediately upon receipt of a shipment and following any transportation or handling accident that could affect the integrity of the capacitor enclosure, the transportation vehicle, enclosure, and fittings should be examined for any leakage or spillage that may have occurred in shipping. If leakage is evident, the cause should be corrected and the spillage soaked up with absorbent materials such as sawdust, followed by a cleanup of the affected area with kerosene or other approved solvent such as perchloroethylene. All materials used should be collected for proper disposition as described in 3.5.

3.7.3 Installation and Periodic Inspection. Large capacitors should be installed in new facilities such that if a leak should develop, askarels can be restrained from reaching the environment. Depending upon the type of installation, consideration may be given to pans, dams, traps, standpipes, dry wells, absorbing agents, etc.

Following installation, the unit should again be inspected for any damage or leakage. It is recommended that periodic in-service inspections be made for leaks.

4. Transformer Guidlines.

4.1 General.

4.1.1 Askarels of various compositional types are currently in use (for the general properties and types, see ASTM D2283-73a(20)). The trademark designations used by manufacturers for liquids containing PCBs are given in Appendix C.

Under arcing conditions, the gases produced, though predominantly consisting of noncombustible hydrogen chloride, can contain varying amounts of combustible gases depending upon the askarel type.

4.1.2 Safety Precautions. Based on about 40 years of safe industrial usage, askarels have been considered as relatively harmless materials to humans There has been no known instance of human injury when askarels are used under the normally prescribed conditions of precaution and handling.

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[illegible] exposure to askarels is not hazardous provided that simple precautions are taken, exposure should still be avoided or minimized.

4.1.2.1 Vapors. The odor of askarel is noticeable well below the maximum safe air concentrations. Depending upon the composition of the askarel used, from 0.5 to 1.0 milligram per cubic meter of air has been determined to be the upper safe level of exposure during an 8-hour workday. (See reference (19)).

The procedure for performing the necessary analysis is contained in ASTM Method D3104 (See Appendix D).

Breathing vapor or fumes from heated askarels should be avoided. High concentrations of vapors can cause irritation of the eyes, nose, throat, and upper respiratory tract. Provisions shall be made for adequate ventilation to avoid open exposure of hot askarels (55°C or higher). The gases produced when askarel is decomposed by very high temperatures (such as that of an electric arc) in the presence of air or organic insulating materials contain a high percentage of hydrogen chloride which is highly toxic, and small percentages of other gases. Minute concentrations of this combination of gases are very unpleasant and irritating, thus giving ample warning of their presence. If exposure to high concentrations of askarels or its arced products is necessary under emergency conditions, an approved gas mask of the organic canister type, or self-contained breathing apparatus, must be worn. Such exposure should be under the surveillance of other personnel capable of effecting rescue in case of accident. If the odor of askarel or its arced products is detected by the person wearing protective equipment, he should immediately go into fresh air. All gas masks, respirators, and replacement parts should have U.S. Bureau of Mines approval and be maintained on a regular schedule in accordance with the manufacturer's recommendation.

4.1.2.2 Liquid. In contrast to the situation in which mineral insulating oils are handled, there is no fire hazard in handling askarels. A limited solvent action (similar to that for paint thinner) on the fats and oils of the skin with prolonged contact may lead to drying and chapping of the skin. As with insulating oil, some people are allergic to askarel, and continued exposure may result in skin irritation. Both the liquid and vapor are moderately irritating to eye tissue.

Operating procedures should require avoidance of contact with any askarels. The use of porous gloves that can absorb and retain askarels is to be avoided. Resistant gloves and aprons such as the polyethylene or fluoro elastomer* type should be used if contact is unavoidable. For some operations, it has been found advantageous to use non-porous, disposable aprons and gloves. In case of spillage on clothing, the clothing should be removed as soon as practical, the skin cleaned with waterless cleaners or solvents such as kerosene, and wiped dry with disposable towels. These towels should be disposed of as PCB contaminated solid wastes. See Section 4.1.6.2.2. Clothing and shoes saturated with askarel should be discarded (burnable waste). Contaminated clothing may be reused providing that

*For example "VITON"

as has been thoroughly cleaned using segregated solvents or a segregated degreaser, then followed by normal laundering. (Laundering alone is not sufficient.)

Medicinal washes or mild detergents followed by the application of cold cream will reduce the irritation resulting from the contact of an open cut or abrasion with askarel.

Safety glasses with side shields or a face shield should be worn when handling askarels. Eyes that have been exposed to liquid askarel should be irrigated immediately with large quantities of running water for approximately 15 minutes and then examined by a physician. (A drop of (U.S.P.) castor oil has been found to reduce irritation.)

Ingestion or swallowing of askarels is not generally regarded as a problem of the industry; however, should accidental ingestion occur, a physician should be consulted.

Hands should be cleaned as noted above before eating, drinking, smoking or using toilet facilities.

4.1.3 Liquid Transport Containers.

4.1.3.1 Transport Container Marking. Any container, such as tank cars, tank trucks, drums, cans, etc., used to transport transformer askarels, new or used, should be labeled with the following (yellow on black):

"CAUTION" Contains PCBs (Polychlorinated Biphenyls) that are environmental contaminants. In case of leaks or spills, restrain discharge and consult manufacturer. In transportation emergencies, call National Response Center (800-424-8802) and Chemtrec (800-424-9300). Avoid prolonged breathing of vapors or mists, contact with eyes or skin. Disposal should be in accordance with ANSI C-107 Guidelines or applicable state and Federal statutes."

4.1.3.2 Spill Procedures - Bulk liquid shipments. See Section 6.

4.1.4 Receiving, Handling, and Storage of Askarels.

Askarels are shipped in tank cars, tank trucks, steel drums, metal cans, and test-sample containers. When received, all containers should be inspected for leaks.

4.1.4.1 Storage Tanks. Storage tanks should be erected so that inspection can be made for leaks or spills. Construction should be such that inadvertent leakage or spills are prevented from reaching streams and sanitary or storm sewers.

4.1.4.2 Tank Cars and Tank Trucks. All bulk shipment equipment should be inspected for leaks immediately upon receipt. Drain pans should be provided to prevent spillage from unloading hoses and connections. Askarel liquid collected in drain pans should be placed in drums labeled "Scrap Askarel" for disposition in accordance with 4.1.6.2.1.

4.1.4.3 Steel Drums, Cans, and Test Sample Containers. On delivery, all such shipments should be carefully inspected for leaks. The containers should be stored indoors in an area especially selected for this purpose. A curb should enclose the area to provide a basin for containing the askarel from one or more containers should the containers be damaged. The area should not have a drain that is connected to a sanitary or storm sewer.

If an indoor storage area is not possible, the containers should be stored under a lean-to with similar containment capabilities.

4.1.5 Control of Water Effluents. The industry goal is to eliminate askarel in water effluent streams. However, it is recognized that existing drain systems from manufacturing plants, repair shops, and installation sites may be contaminated as a result of past practices. Other sections of this standard provide that no askarel wastes of any kind be disposed of in any water effluent streams and that accidental spills be prevented from getting into such streams.

4.1.5.1 Concentration limits. The EPA has proposed water quality criteria to maintain PCB concentration in rivers and lakes below detection level. Requirements under Sections 307(a), 307(b), and 311 of the 1972 Amendments to the Federal Water Pollution Control Act are under review (1976-77) and the latest revisions will apply. State and municipal requirements must also be met.

Further information may be obtained from the Environmental Protection Agency Regional Office. A listing of these offices is contained in Appendix D.

4.1.5.2 Monitoring Streams. All plant effluent streams should be monitored on a regular basis. The procedure for performing the necessary analysis is contained in ASTM Method D3304 (See Appendix B).

4.1.5.3 Methods for Minimizing Effluent Stream Contamination. The ideal approach is to totally isolate all effluents that could be contaminated with askarels during manufacturing processes and prevent them from being discharged from the plant.

4.1.6 Disposal procedures and Services.

4.1.6.1 Sources of Materials Requiring Special Handling and Disposal Procedures. Liquids containing PCBs and solids containing or contaminated with PCBs may come from many sources including transport containers, transformer manufacturing processes, in-test failures, liquids contaminated beyond reclamation, in-service transformer leaks and failures, askarel-filled transformers scrapped for any reason, sample containers and handling equipment.

4.1.6.2 Classification for Disposal of Materials Containing PCBs. In general, there are four types of materials requiring disposal: burnable liquids contaminated with PCBs; nonburnable liquids contaminated with PCBs; burnable solids contaminated with PCBs; and nonburnable solids contaminated with PCBs.

4.1.6.2.1 Burnable Liquids. Liquids containing PCBs requiring disposal by high-temperature incineration may consist of the following:

(1) PCBs contaminated with mineral oil.

(2) Mineral oil contaminated with PCBs.

(3) Nonreclaimable contaminated transformer askarels, arced askarels, askarels from manufacturing spills, sump accumulation, askarels from holding basins, drip and drain pans, washings, sample jars and containers, etc.

4.1.6.2.2 Nonburnable Liquids (Water) Contaminated with PCBs. Water contaminated with PCBs may be treated by such means as activated carbon filtration or by a reductive dechlorination process, providing that the effluent meets Federal and State water effluent standards. Such liquids may also be disposed of, packed in suitable containers, in approved landfills. See Appendix A.

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4.1.6.2.3 Burnable Solid Waste Materials Contaminated with PCBs. These materials can be disposed of by high-temperature incineration and consist of cellulosic materials, rags, pressboard, wood, sawdust, fuller's earth in bulk or in cloth bags, blotter papers, nitrile or cork gaskets, etc.

4.1.6.2.4 Nonburnable Solid Waste Materials Containing or Contaminated with PCBs. These materials may consist of steel, copper, aluminum, filter units of the steel mesh construction type, askarel drums, cans, etc.

Materials of this nature should be allowed to drain with liquids collected in drip pans, etc. Further removal of adhering PCBs should be accomplished by vapor degreasing, washing or solvent extraction with kerosene or other approved washing liquids such as perchloroethylene. Accumulated liquids should be disposed of as indicated in 4.1.6.2.1. Solid materials as cleaned above may be handled as normal scrap.

Coil structures may be dismantled with burnable material removed. Metals should be treated as noted above, and burnable solids disposed of in accordance with Section 4.1.6.2.3. An alternative but less desirable procedure for disposal of coils, cores, burnable waste, etc., is to suitably package and bury in an approved landfill site. See Appendix A.

4.1.6.3 Shipment of Scrap Liquids For Disposal. All liquid scrap material should be placed in appropriate metal transport containers, properly labeled (Section 4.1.3.1) for shipment to a company offering an acceptable disposal service (Appendix A).

4.1.6.4 Shipment of Burnable Solid Waste Material Containing PCBs for Disposal. Material of this type should be placed in a liquid-tight container meeting Federal and State transportation requirements, and acceptable to the disposal organization. The container should be properly labeled (Section 4.1.3.1) for shipment to a company offering an acceptable disposal service (Appendix A).

4.1.6.5 Liquid and Solid Waste Disposal Service Organizations. These facilities should meet the applicable requirements of the state in which they are located and should control effluents within the limits referred to in Section 4.1.5.1.

4.2 Guidelines for Original Manufacture, Service and Repair Shops.

4.2.1 Plant Housekeeping It is necessary to assume that in filling equipment with askarel, and during further handling of this equipment, an askarel spill may occur. Therefore, it is necessary to provide facilities and a procedure for cleanup to prevent contamination.

4.2.1.1 Askarel Filling Area.

4.2.1.1.1 It is desirable that the askarel filling area be adjacent to the test area and final shipping area to minimize the danger of damage to units during handling.

4.2.1.1.2 The main manufacturing area for filling equipment with askarel should be provided with impervious surface floors or suitable basins so constructed that any inadvertent leakage or spills are prevented from reaching streams, sanitary sewers, or storm sewers. All askarel-handling equipment, such as pumps, hoses, etc., shall be of the askarel-resistant type.

4.2.1.1.3 Drip pans shall be provided for hose connections and filling valves.

4.2.1.2 Special Containers for Scrap Materials.

4.2.1.2.1 Drums labeled "SCRAP ASKAREL" should be available for handling all spilled and waste askarel from sumps, failed units, drip pans, sample jars, etc.

4.2.1.2.2 Open-head drums with suitable closures and labeled "SCRAP BURNABLE ASKAREL WASTE" should be available for handling contaminated cellulose insulation, rags, paper, pressboard, wood, gaskets, sawdust, etc.

4.2.1.2.3 Separate containers for handling steel, copper, and aluminum, each adequately marked, shall be provided for the components of contaminated core and coil assemblies. These containers are required for the various materials when repairing or scrapping assemblies.

4.2.1.2.4 Containers for supplies of materials for absorbing small askarel spills or cleanup of larger spills should be provided.

4.2.1.3 Conditioning of Askarels.

4.2.1.3.1 Askarel Conditioning Equipment. The conditioning unit should be located either in the storage tank area or in the main transformer manufacturing area for filling with askarel.

4.2.1.3.2 Fuller's Earth. Conditioning of new askarel or recycled askarel requires fuller's earth treatment. The spent fuller's earth in cartridges or bags, when replaced, should be allowed to drain thoroughly over drip pans to remove as much liquid askarel as possible. The cartridge units of steel mesh construction should be placed in the "STEEL CONTAMINATED WITH ASKAREL" container for disposition. Cloth bags filled with fuller's earth should be placed in the "SCRAP BURNABLE ASKAREL WASTE" container for disposition.

4.2.1.4 Teardown of Units for Repair or Scrap.

4.2.1.4.1 Drain all askarel from the unit either into a holding tank for reuse or into the drum labeled "SCRAP ASKAREL" for disposition, allowing sufficient time for all of the askarel to drain from the core and coils.

4.2.1.4.2 Remove the core and coil assembly from the transformer tank and place over a suitable drip pan.

4.2.1.4.3 Place all materials in the appropriate salvage containers during dismantling for later disposition.

4.2.1.4.4 All used materials, including rags, sawdust, tape, etc., regardless of quantity, shall be put into the appropriate containers for disposition.

4.2.2 Transformer Labeling and Shipment

4.2.2.1 New and Rebuilt Transformers. All new and rebuilt transformers that contain PCBs shall have a label of adequate durability, permanently and prominently attached to the tank by the manufacturer, giving adequate warning and instructions. A suggested label, yellow on black, includes the following:

"CAUTION" Contains PCBs (Polychlorinated Biphenyls) that are environmental contaminants. In case of leaks or spills, restrain discharge and consult manufacturer. In transportation emergencies, call National Response Center (800-424-8802) and Chemtrec (800-424-9300). Avoid prolonged breathing of vapors or mists, contact with eyes or skin. Disposal should be in accordance with ANSI C-107 Guidelines or applicable state and Federal statutes."

4.2.2.2 In-Service Transformers. The transformer manufacturer should make available suitable labels with similar warning as shown in 4.2.2.1 for use on existing transformers.

4.2.2.3 Shipping papers should contain the warning

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4.2.3 Information for Transformer Users

4.2.3.1 General. Askarel-filled transformers are delivered to customers as sealed units from which there is no escape of askarel under normal operation. Although certain types of equipment failures can permit loss of some askarel to the environment, such cases are extremely rare.

4.2.3.2 Transportation and Receiving. Immediately upon receipt of the equipment and following any transportation or handling accident that could affect the integrity of the tank, bushings, or radiators, the transportation vehicle, tank, and fittings should be examined for any leakage or spillage that may have occurred in shipping. If leakage is evident, the cause should be corrected and the spillage soaked up with absorbent materials such as sawdust, followed by a cleanup of the affected area with rags soaked with kerosene or other approved solvent such as perchloroethylene. All materials used should be collected for proper disposition as described in 4.2.3.

4.2.3.3 Installation and Periodic Inspection. Transformers should be installed so that if a leak should develop, askarels can be retained from reaching the environment. Depending upon the type of installation, consideration may be given to pans, dams, traps, standpipes, dry wells, absorbing agents, etc.

Following installation, the unit should again be inspected for any damage or leakage. It is recommended that periodic in-service inspections be made for any leaks.

4.2.3.4 Filling, Filtering, or Drying Askarel. Most askarel units are shipped with the proper amount of askarel, but if it becomes necessary to top off a unit, the manufacturers's instructions should be followed.

If it is necessary to dry an askarel unit or to treat an askarel unit with fuller's earth, instructions should be followed. When filtering or conditioning askarel, all of the precautions previously described for drip pans, proper disposal of filter media, etc. apply.

4.2.3.5 Sampling. It is common practice to sample askarel from a transformer for periodic maintenance testing. As previously described, such samples should be taken in a manner to avoid any contamination of the environment. Washings should be collected for proper disposal. Field and laboratory test samples, washings, etc., should also be collected for proper disposal.(See Section 5).

4.2.3.6 Transformers Installed in Moving Vehicles. In the event of a leak or accidental spill, the procedures outlined in Section 6 should be followed.

4.3 Retrofilling Apparatus Containing Askarels. It is not recommended that apparatus containing PCB liquids be changed to other liquids. It is recognized that the best possible change-out procedures will still leave appreciable PCBs in the apparatus. Apparatus that has contained PCBs which has been replaced with another fluid should be labeled as indicated below, and the disposal ultimately should follow the same disposal procedures as those recommended for PCB liquids and PCB-filled apparatus.

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Label (yellow on black)

CAUTION: Contains liquid contaminated with PCBs an environmental contaminant. Changed to (describe liquid) on (give date).

4.4 Transformer Disposal.

The ultimate disposal of a PCB-containing transformer may be accomplished by the following procedures:

1. Contract with a qualified organization for disposal of the complete transformer.

2. Where acceptable facilities are available, the following alternative procedures are recommended:

   (a) Always drain the liquid and dispose of it by approved incineration.

   (b) For the solid components or for the entire structure, either of the following procedures are recommended:

      i. Dismantle, wash and dispose in accordance with Section 4.1.6.

      ii. Ship entire solid structure to acceptable organization for disposal.

      iii. Ship to acceptable landfill disposal site. (See Appendix A).

5. Disposal of Laboratory Samples Containing PCBs.

The disposal of laboratory samples and materials used for testing and experimental purposes which contain, are impregnated with, or contaminated by PCBs (askarels) must be carefully controlled. Their disposition should be made in a manner consistent with procedures in 3.5.2 and 3.5.3 (Capacitors) and 4.1.6 (Transformers).

6. Spill Notification and Control Plan

Polychlorinated Biphenyl(PCBs)

The immediate actions needed are to contain or restrain liquid spills with the best means available and to notify "CHEMTREC" and "The National Response Center."

"The basis for this spill notification and control plan relies on Chemtrec to advise on the immediate actions needed to contain or restrain the liquid spill with the best means available based on listed instructions. The National Response Center will notify all interested parties, i.e. Federal and State authorities and the manufacturers involved, as well as give guidance on action to be taken."

FAILURE TO REPORT SPILLS TO PROPER AUTHORITIES MAY RESULT IN CRIMINAL PENALTIES.

6.1 Chemtrec

6.1.1 What is it. - Chemtrec stands for Chemical Transportation Emergency Center, a public service of the Manufacturing Chemists Association at its offices in Washington, D.C.

Chemtrec provides immediate advice for those at the scene of emergencies, then promptly contacts the shipper of the chemicals involved for more detailed assistance and appropriate follow-up.

Chemtrec operates around the clock - 24 hours a day, seven days a week - to receive direct-dial toll-free calls from any point in the continental United States through a wide area telephone service (WATS) number, 800-424-9300 (483-7616 for calls originating within the District of Columbia; 202-483-7616 for calls originating outside the continental U.S.).

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6.1.2 It is recommended that all past and present manufacturers of PCBs and PCB-containing equipment be listed with Chemtrec.

Contact "ChemNAC" at the manufacturing Chemists Association, 1825 Connecticut Ave., N.W., Washington, D.C. 20009.

6.2 National Response Center.

6.2.1 Work in it -

Location: U.S. Coast Guard Headquarters, Nassif Building, 400 7th Street, S.W. Washington, D.C. 20590.

Function: To coordinate pollution emergencies when national involvement is required. Nationwide Reporting Network for receiving pollution reports. The basis of this network is a well publicized toll-free telephone number (800-424-8802) which anyone may use to call the National Response Center reporting pollution incidents or accidents which may result in pollution.

Relay of Pollution Reports to the local representatives of the Federal Agency responsible for action when a pollution discharge has occurred. When necessary, other specific local, regional, or national representatives for the various agencies will also be notified.

6.3 Shipment of Liquids and Equipment Containing PCBs.

6.3.1 Labeling: All containers and equipment containing PCBs shall be labeled in accordance with sections 3.6, 4.1.3, 4.2.2.1 and 4.3.

6.3.2 Shipping Papers. Shipping papers should contain the following warning statement:

CAUTION: Contains PCBs(askarel) that are environmental contaminants. In case of leaks, or spills, restrain discharge, DO [illegible]. For further instructions call Chemtrec (800-424-9300) and the manufac[illegible] National Response

6.4 Installation Equipment

It is recommended that all users should have an on-site spill prevention counter-measure and control plan which should be followed in the event of an accident.

6.4.1 Capacitors

Capacitors should be installed in accordance with 3.7.3.

6.4.2 Transformers

Transformers should be installed in accordance with Section 4.2.3.3.

6.4.3 Spills

In case of liquid spills due to leaks or equipment failures the procedures outlined in sections 3.7.2 for capacitors and 4.2.3.2 for transformers should be followed.

7. REFERENCES

7.1 References to Text

(1) Standard Method of Test for Rapid Gas Chromatographic Estimation of High Boiling Homologues of Chlorinated Biphenyls for Capacitor Askarels,[ASTM D3303-74].

(2) American National Standard Method of Test for Specific Gravity of Askarels, C59.1965 (R1973) [ASTM D 1610-63 (1973)].

(3) American National Standard Method of Test for Neutralization Number by Color-Indicator Titration, Z11.131-1964 (R1974) [ASTM D 974-64 (1973), IP 139/65].

(4) American National Standard Method of Test for Neutralization Number by Potentiometric Titration, Z11.59-1958 (R1971) [ASTM D664-58 (1968), IP 177/64].

(5) Standard Method of Test for Density of Rubber Chemicals,[ASTM D 1817-66 (1972)].

(6) American National Standard Method of Test for Inorganic Chlorides in Askarels, C59.55-1963 (R1973)[ASTM D 1821-63 (1973)].

(7) American National Standard Method of Test for Pour Point of Petroleum Oils, Z11.5-1966 (R1972) [ASTM D 97-66 (1971), IP 15/67)].

(8) American National Standard Method of Test for Power Factor and Dielectric Constant of Electrical Insulating Liquids, C59.22-1967 (R1973)[ASTM D 924-65 (1973)].

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(9) American National Standard Method of Test for Specific Resistance (resistivity) of Electrical Insulating Liquids, C59.51-1965 (R1973) [ASTM D 1169-64 (1973)].

(10) American National Standard Method of Test for Hydrolyzable Chlorine Compounds in Chlorinated Aromatic Hydrocarbons (Askarel) C59.106-1970 [ASTM D 1820-65 (1971)].

(11) American National Standard Method of Test for Thermal Stability of Chlorinated Aromatic Hydrocarbons (Askarels), C59.111-1970 [ASTM D 1936-64 (1971)].

(12) American National Standard Method of Test for Distillation of Road Tars, A37.9-1974 [ASTM D20-72].

(13) American National Standard Methods of Testing Electrical Insulating Oils, C59.2-1974 ASTM D 117-71 (1973)

(14) American National Standard Method of Test for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes, C59.19-1968 (R1973) [ASTM D 877-67 (1971)].

(15) American National Standard Method of Test for Flash and Fire Points by Cleveland Open Cup, Z11.6-1973 [ASTM D 92-74, IP 36/67].

(16) American National Standard Method of Test for Saybolt Viscosity, Z11.2-1956 (R1971) [ASTM D 88-56 (1973)].

(17) American National Standard Method of Test for Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels, C59. 57-1963 (1973) [ASTM D 1903-63 (1973)].

(18) MUNCH, R.H. Measuring the dissipation factor, dielectric constant, and resistivity of liquids. Insulation/Circuits, vol 16, Mar. 1970, pp 46-49.

(19) Chlorodiphenyls. Hygienic Guide Series. Westmont, New Jersey: American Industrial Hygiene Association, Jan-Feb 1965.

(20) Standard Specification for Chlorinated Aromatic Hydrocarbons (Askarels) for Transformers, [ASTM D 2283-73a].

7.2 General References

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TREON, J.F.; CLEVELAND, F.P.; CAPPEL, J; and ATCHLEY, R.W. The toxicity of the vapors of Aroclor 1242 and Aroclor 1254. American Industrial Hygiene Association Quarterly, vol. 17, 1956, pp 204-211

8. REVISION OF AMERICAN NATIONAL STANDARDS REFERRED TO IN THIS DOCUMENT.

When the American National Standards referred to in this document are superseded by a revision approved by the American National Standards Institute, Inc., the revision shall apply.

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APPENDIXES

(These Appendixes are not a part of American National Standard Guidelines for Handling and Disposal of Capacitor - and Transformer-Grade Askarels Containing Polychlorinated Biphenyls, C107.1 -197__, but are included for information purposes only.

APPENDIX A

Disposal Services

In addition to the supervised dry land fill sites that may be used for the disposal of askarel-containing scrap, the following additional known facilities and services have been established. For other facilities, call your regional Environmental Protection Agency Office. (See Appendix D).

The firms listed below (not all-inclusive) will accept PCBs for treatment or disposal, as noted. The Environmental Protection Agency does not endorse any of these firms [illegible] for the environmental [illegible] of their operations. Each of these firms has been contacted and reports having the required technical characteristics to adequately handle PCBs, in accordance with Recommended Procedures for the Disposal of PCB-Containing Waste (Industrial Facilities) as published by EPA in the Federal Register. The appropriate Boards of EPA Regional Offices should be contacted for environmental suitability of the firm/site.

1. California Class I Landfills

(a) Casmalia Disposal Site
Santa Barbara, California (800-969-4703)
Bulk liquids and drummed materials.

(b) IWM Corporation
Wilmington, California (213-775-3607)
All forms.

(c) Environmental Protection Corporation
Bakersfield, California
All forms.

(d) County of Los Angeles
Whittier, California (213-699-7411)
Facilities: Palos Verdes Calabasas
All forms.

(e) San Diego County
San Diego, California (714-565-5703)
All forms

(f) Ventura County Dept. of Public Works
Ventura, California (805-648-2717)
All forms.

(g) Richmond Sanitary Service
Richmond, California (415-234-3304)
All forms.

2. Chemical Waste Disposal Co.
Elizabeth, N.J. (201-351-5460)
Disposal by incineration

3. Chem-Trol Pollution Services, Inc.
P.O. Box 200
1550 Balmer Road
Model City, N.Y. 14107
Phone: 716-754-8231

Can handle solids and liquids by incineration or land disposal.

This organization has facilities and services capable of handling:

(1) Liquids. Askarels alone or mixed with solvents or oils. Disposal by high-temperature incineration.

(2) Solids (software). Askarel-soaked compounds, rags, cartons, absorbing earths, etc. Disposal by incineration or scientific landfill.

(3) Solids (hardware). Capacitors, transformer tanks, cores, askarel-soaked metals. Disposal by scientific landfill. Has solvent extraction capability.

4. Hyon Waste Management Services, Inc.
Chicago, Ill. (312-646-0016)

Can handle solids and liquids by incineration.

5. Monsanto Company
800 North Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: 314-694-3352

Handles only liquid askarels manufactured by Monsanto. Disposal is by incineration.

This organization has facilities and services capable of handling askarel liquids alone or mixed with other oils or solvents by high-temperature incineration. Liquid is pumped through a gun with atomizing steam into incinerator.

Temperatures are maintained at 2000°F with auxiliary natural gas. Exit gases are quenched to 180°F by contact with water. Gas is then passed through a high-energy venturi scrubber for removal of particulates. Before exhausting to air (110°F, gases are passed through a packed column scrubber to remove HCl. Askarel liquids containing more than 1% water, or any phosphate esters cannot be accepted.

6. Nuclear Engineering Co., Inc.
Louisville, KY. (502-426-7160)

Facilities: Sheffield, Ill.
Beatty, Nev.

Disposal by landfill: Can handle drummed liquids and solids.

Nuclear Engineering Company
Beatty Division
P.O. Box 240
Beatty, Nv. 89351
Phone: 800-634-6011

Nuclear Engineering Company
Sheffield Division
Sheffield, Ill. 61341
Phone: 815-454-2424

The organization provides containerization, transportation, and disposal services of all liquids and solids (including hardware). Disposal is in controlled chemical and scientific landfill area. Licensed by Atomic Energy Commission for radioactive waste disposal. The organization also has two West Coast locations, in the states of California and Washington.

7. Rollins Environmental Services, Inc.
P.O. Box 2349
Wilmington, Delaware 19899
Phone: 320-655-8541

This organization has facilities and services capable of handling:

(1) Liquids. Askarel alone or mixed with solvents or oils. Disposal is by high-temperature incineration.

(2) Solids (soft-ware). Askarel-soaked compounds, rags, cartons, absorbing earths, etc. Disposal is by incineration at combustion temperatures up to 2500°F. Incineration gases are scrubbed, and entrained solids are removed before exhausting to air.

Rollins Environmental Services maintains disposal facilities in the following areas:

Philadelphia/Camden:
Rollins Environmental Services, Inc.
Route 322
Logan Township
Bridgeport, New Jersey 08014

Baton Rouge:
Rollins Environmental Services, Inc.
Scenic Highway & West Cheatham Lane
Scotlandville
East Baton Rouge Parish, La. 70807

Houston:
Rollins Environmental Services, Inc.
Tidal Road & Highway 134
Deer Park, Texas 77536

8. Texas Ecologists, Inc.
Robstown, Texas
Phone: 512-387-3518

Disposal by landfill..

9. Wes Con, Inc.
Twin Falls, Idaho (208-733-0897)

Receive packaged materials for disposal in missile silos.

10. Gedcor Environmental Protection Corp.
1513 Newburgh Rd.
Westland, Michigan 48185
Phone: 313-326-0600

Will accept transformers, capacitors and PCBs solidified in Imbiber* beads.

APPENDIX B

ANALYTICAL PROCEDURES AND LABORATORY SERVICE ORGANIZATIONS.

B1. General

Analysis for PCB in environmental samples is a tedious process due to the very low levels (ppb or ppt) which are of interest and due to the high sensitivity of the electron capture chromatographic procedure. It cannot be overemphasized that extreme care must be taken to ensure first that the sample is representative and second that sufficient numbers of blanks,

*Dow Chemical Corp.

and sample replicates are tested to define detectability limits and precision of the particular equipment and procedure being used. Cleanliness of sampling devices and containers and their extraction is also important. Analytical procedures for the determination of PCBs in air, water and sediments are given in section B3.

B2. Laboratories

For a listing of laboratories offering services for PCB analysis refer to Directory of Testing Laboratories publication STP333A available from the American Society for Testing and Materials (ASTM) 1916 Race Street, Philadelphia, Pa. 19103. If an outside laboratory is used, a verification of capability is recommended.

B3. Analytical Procedures

See ASTM D3304-74, "Analysis of Environmental Materials for Polychlorinated Biphenyls".

APPENDIX C

TRADEMARK DESIGNATIONS USED BY MANUFACTURERS FOR LIQUIDS CONTAINING PCBs.

Capacitors or transformers in service and liquid shipments showing the following trademark designations contain PCBs. Those have been or are in use and usually the designation appears on the nameplate or the warning label.

DOMESTIC

NAME	MANUFACTURER
Aroclor	Monsanto
Aroclor B	Mallory
Asbestol	American Corporation
Askarel*	Hevi-Duty Corporation
Askarel*	Ferranti-Packard Ltd.

DOMESTIC

NAME	MANUFACTURER
Askarel*	Universal Mfg. Company
Chlorextol	Allis-Chalmers
Clorinol	Sprague Electric
Clorphen	JARD Company, Inc.
Diaclor	Sangamo Electric
Dykanol	Cornell Dubilier
Elemex	McGraw Edison
Eucarel	Electric Utilities Corp.
Hyvol	Aerovox
Inerteen	Westinghouse Electric
No-Flamol	Wagner Electric
Pyranol	General Electric
Saf-T-Kuhl	Kuhlman Electric

OFFSHORE

Clophen	Bayer (Germany)
Fenclor	Caffaro (Italy)
Kennechlor	Kenneclor (Japan)
Phenoclor	Prodelec (France)
DK	Caffaro (Italy)
Pyralene	Prodelec (France)
Pyroclor	Monsanto (UK)
Solvol	USSR

*World-Wide generic name used for insulating liquids in capacitors and transformers that usually contain PCB's.

APPENDIX D

ENVIRONMENTAL PROTECTION AGENCY REGIONAL OFFICES.

Environmental Protection Agency
Region I, Room 2303
John F. Kennedy Federal Building
Boston, Massachusetts 02203
Telephone: 617-223-7265

Environmental Protection Agency
Region II, Room 909
26 Federal Plaza
New York, New York 10007
Telephone: 201-548-8730

Environmental Protection Agency
Region II
Curtis Bldg., 6th & Walnut Sts.
Philadelphia, Pa. 19106
Telephone: 215-597-9898

Environmental Protection Agency
Region IV
1421 Peachtree Street, N.E.
Atlanta, Georgia 30909
Telephone: 404-526-5062

Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604
Telephone: 312-896-7591

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Environmental Protection Agency
Region VI, Suite 1000
1600 Patterson Street
Dallas, Texas 75201

Environmental Protection Agency
Region VII
1735 Baltimore Avenue
Kansas City, Missouri 64108
Telephone: 816-374-5776

Environmental Protection Agency
Region VIII, Suite 900
1860 Lincoln Street
Denver, Colorado 80203
Telephone: 303-837-3880

Environmental Protection Agency
Region IX
100 California Street
San Francisco, California 94111

Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101
Telephone: 206-442-1283

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