Environment

The huge water requirements of the chemical industry now the nation's third largest user—make water quality and availability key materials and supply factors for site selection. Legislation enacted in recent years has forced plants to provide investments in pollution control equipment.

All 50 states have established their water quality standards (approved entirely or in part by the Federal Water Pollution Control Administration (FWPCA). Recently a state-by-state summary of these standards was published by the FWPCA. Surprisingly it was not the FWPCA that did the job. Instead it was undertaken by the American Public Health Assn. (APHA) subcommittee headed by TVA Health Director T. E. Gentzel assisted by the APHA Engineering and Sanitation Section. A portion of the study covering standards for surface industrial water is summarized in the tables starting on p. 50.

Contrary to widely held opinions, there is considerable variation in state standards. Take the dissolved oxygen (DO) standard, for example. Maximum allowable DO (as milligrams per liter or percent saturation) is the single most important standard to chemical site evaluators. As a rough rule of thumb, a 2 mg/l standard is considered to be one industry can live with comfortably, while a 6.0 mg/l value is pegged "extremely tough."

California, Wyoming and Washington have set the standard at 6 mg/l or higher. But a few states such as Connecticut, Maine, Illinois, Indiana, Massachusetts, Virginia and Wisconsin require 2 mg/l or lower.

Other standards—usually turbidity, taste, odor, color and solids—may also be important, depending upon the nature of the chemical plant's waste effluents. These standards also exhibit state-by-state differences. Moreover, they are generally less specific than the strictly numerical DO standards.

Although chemical plant site experts see little point in "fussing" over state standards, the criteria do make a difference. Plans for two petroleum refining plants in Puerto Rico are now on the shelf because air standards could call for a 4.5 mg/l DO. Laws were thus interfere with the economics of the water treatment operations.

No compilation of ground water standards has yet been published. Ground water standards may prove important in the future as competition for good water supplies increases. Deep well disposal for wastes. Availability of ocean waste disposal services is also becoming more important.

Waste Costs. The price tag for pollution control is high. A recent FWPCA study on the cost to the chemical industry estimated that water wash petroleum refineries can have installed a total evaporative waste 9% or more. Between 1970 and 1973 the organic chemical industry would have to shell out $182 million to remove 1.6 million tons of its biological and chemical oxygen demand wastes and 0.5 million tons of suspended solids. Some of the less efficient 9%, 11% and 13% treatment levels for the organic chemical industry's biological oxygen demand and suspended solids would be, respectively, $1,000 per ton, $2,000 per ton and $3,000 per ton, with a high of $4,000 per ton.

Clean Air Act. Implementation of the standards to meet air quality criteria established by the National Air Pollution Control Administration (NAPCA) under the Clean Air Act of 1967 is now underway. Most states have established their air quality standards and another 21 have been approved. NAPCA's control of quality criteria and control techniques documents and publication of emission standards follow with the states responsible for enforcement.

Once emission standards have been established, permanent and control equipment have been designed and installed, process investment standards between the implementation and enforcement plans will be minimized that can take several years to produce results.

So far, no firm sulfur oxide or particulate standards have emerged. But NAPCA's criteria for setting the standards suggest they will be tough. The oxide criteria report for example suggests that there are deleterious effects to plant and animal life from concentrations as low as 0.03 ppm.

NAPCA's control data reports present detailed projections of costs of various methods and equipment along with operating costs. As in the case of water, the costs will be high. Control of some pollutants—mainly sulfur dioxide—will have recovery values. NAPCA is sponsoring a number of research projects to improve technology. Pollution control is being encouraged by financial assistance programs (mandated by state law) now operative in the following 26 states:

Arizona, Arkansas, California, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Maine, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, Washington, Wisconsin and West Virginia.

In addition, Pennsylvania offers financial and sanctioned administrative regulation. Several states including Colorado and Maryland have legislative studies underway.

The incentives take a variety of forms. Most common are exemption from personal property taxes (e.g., Illinois), depreciation (Arizona), exemption from sales tax on equipment and structures taxes (Connecticut), exemption from local taxes for stated period of time (New Hampshire), operating loss deductions (New York), credit against income taxes (Oregon).

Quantity. The large chemical complexes now on stream make water—and lots of it—a major site criterion. The softer the water is, the better for it can reduce the investment in heat exchange equipment. Occasionally plants can get by on ground water, but usually surface water is required. This means location on or near the big drought-prone rivers. There are less than 200 rivers in the U.S. that have flows of over 50 cubic feet per second (CFS). Only 5% of these flow over 50 CFS. For companies whose plant needs at least 100 cfs, the list of rivers shrinks to only 150 (excluding Alaska). Some of the generally overdeveloped rivers of the Northeastern states.

Pipeline water is expensive. Usual source of supply is from reservoir surface water. In the arid Southwest, where water is scarce, a 36-mile pipeline has been built to supply a petrochemical complex. Cost of the water supply system has been disclosed but it is estimated that the line was over several million dollars.

The adequacy of data on the water resources in the U.S. has recently been evaluated by the Geological Survey. Survey estimates projected demand will be 12% of present supply. Only in three regions—New England, the South Atlantic-Gulf and the Pacific Northwest—will demand exceed 20% of supply. Regions with the greatest demand are the Great Lakes, Lower Mississippi, Upper Mississippi, Missouri, Arkansas-White-Red, Texas-Gulf, Rio Grande, Upper Colorado, Great Basin and California-South Pacific.

MONS 219722

For the first time, a summary of water quality standards set by all 50 states...

	pH Allowable Range	Deviation	Temperature (°F) Maximum	Increase above natural	Dissolved O2 (mg/l) Minimum	Other Requirements
Alabama	6.0-8.5	1.0	90° (surface) 93° (any 8 hrs.) 93° (cooling water)	10° — 10°	2.0 (in the main body of stream, but not less than 1.0 in limited areas)	Radioactivity: Color, Turbidity and Taste: ... Toxic ... and ... to cause ... to ... or ... or ... or

	pH Allowable Range	Temperature (°F) Allowable Maximum	Increase Over Natural	Dissolved Oxygen (mg/l) Minimum	Other Requirements
Georgia	6.0-8.5	--	93.2°	10° (at the mixing zone)	2.0 (daily average)	Color, Taste and Odor: Free from wastes that produce taste or odor in such degree as to create a nuisance or render any undesirable taste to fish flesh or other edible aquatic products, or that are toxic to fish or other aquatic life. Turbidity: Free from wastes in amounts that would prevent the attainment of the natural clarity of the receiving waters. Toxic Substances: Free from wastes in concentrations that would produce harmful effects upon fish, other aquatic life, or water unsuitable for industrial use.
Hawaii	6.5-8.5	—	—	—	4.5	Radioactivity: Not to exceed 1/30 of the limit specified in Standards for Drinking Water of the U.S. Public Health Service. Color, Turbidity, Taste and Odor: Free from substances that will cause taste or odor in edible aquatic life, or that will cause turbidity or color in such amounts as to reduce the depth of the compensation point for photosynthetic activity by more than 10 percent or to reduce the visibility of a Secchi disc more than 10 percent. Toxic Substances: Free from substances in concentrations that will be toxic to aquatic life after reasonable mixing. Wastes shall not contain substances that will bioaccumulate in aquatic life to levels that will be harmful to human health. Floating Solids, Oil and Grease: Free from floating solids, oil and grease of petroleum origin. Temperature: Not to exceed 1°F change from natural temperature. Nutrients: Not to exceed amounts that will cause objectionable growths of algae or other aquatic life.
Idaho	6.5-9.0	0.5	—	2° Only if 68° or less	7.0 mg/l (winter season 6.5 mg/l)	Radioactivity: Not to exceed 1/30 of the limits specified in Standards for Drinking Water of the U.S. Public Health Service. Color, Taste and Odor: Free from substances that will cause taste or odor in edible aquatic life, or that will cause turbidity or color in such amounts as to reduce the depth of the compensation point for photosynthetic activity by more than 10 percent or to reduce the visibility of a Secchi disc more than 10 percent. Toxic Substances: Free from substances in concentrations that will be toxic to aquatic life after reasonable mixing. Wastes shall not contain substances that will bioaccumulate in aquatic life to levels that will be harmful to human health. Floating Solids, Oil and Grease: Free from floating solids, oil and grease of petroleum origin. Temperature: Not to exceed 1°F change from natural temperature. Nutrients: Not to exceed amounts that will cause objectionable growths of algae or other aquatic life.
Illinois	6.0-9.0	—	95°	—	2.0 3.0 (for 16 hrs in any 24 hr period)	Color, Taste and Odor: Free from wastes that produce taste or odor in such a degree as to create a nuisance or render any undesirable taste to fish flesh or other edible aquatic products, or that are toxic to fish or other aquatic life. Turbidity: Free from settleable solids and floating debris. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Indiana	6.0-9.0	—	95°	—	4.0 5.0 (daily average)	Color, Taste and Odor: Free from wastes that produce taste or odor in such a degree as to create a nuisance. Solids: Dissolved solids must not exceed 1500 mg/l. Chlorides not to exceed 250 mg/l. Turbidity: Free from settleable solids, cutbacks or deposits or otherwise objectionable wastes. Toxic Substances: Free from substances in concentrations or combinations harmful to human, animal, plant or aquatic life.
Iowa	—	—	—	—	—	Color, Taste and Odor: Free from wastes that produce taste or odor in such a degree as to be detrimental to the use of the waters for any lawful purpose or beneficial use. Solids: Free from floating oil, scum and other floating materials in amounts sufficient to cause nuisance conditions. Turbidity or Color: Free from wastes in amounts sufficient to cause nuisance conditions. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life or to industrial use.
Kansas	6.5-9.0	—	90°*	—	4.0*	Turbidity: No increase that causes substantial visible contrast with natural appearance of the receiving water. Color: Discharges of color producing substances shall be limited to those amounts that will not cause substantial visible contrast with natural appearance of the receiving water. Solids: Free from floating solids in amounts sufficient to cause nuisance conditions. Toxic Substances: Free from substances in concentrations detrimental to the propagation of fish, aquatic life and wildlife or injurious to human health.
Kentucky	6.0-9.0	--	85° 73° (Dec.-Feb.)	2°/hr 10°/day	—	Color, Taste and Odor: Wastes shall not cause taste or odor in edible fish flesh. Solids: Dissolved solids shall not exceed an average of 500 mg/l. Turbidity: Wastes shall not cause turbidity in excess of that which would interfere with the propagation of fish or other aquatic life. Toxic Substances: Wastes shall not contain toxic substances in concentrations or combinations that will be harmful to human health or aquatic life.
Louisiana	6.0-9.0	—	96.8°	5.4*	50%	Radioactivity: Not to exceed limits established by the Public Health Service Standards. Color, Taste and Odor: Free from substances that will cause taste or odor in edible aquatic life, or that will cause turbidity or color in such amounts as to reduce the depth of the compensation point for photosynthetic activity by more than 10 percent or to reduce the visibility of a Secchi disc more than 10 percent. Toxic Substances: Free from substances in concentrations that will be toxic to aquatic life after reasonable mixing. Wastes shall not contain substances that will bioaccumulate in aquatic life to levels that will be harmful to human health. Floating Solids, Oil and Grease: Free from floating solids, oil and grease of petroleum origin. Temperature: Not to exceed 1°F change from natural temperature. Nutrients: Not to exceed amounts that will cause objectionable growths of algae or other aquatic life.
Maine	6.0-9.0*	0.5*	90°*	—	2.0*	Radioactivity: Not to exceed 1/30 of the limits specified in Standards for Drinking Water of the U.S. Public Health Service. Color, Taste and Odor: Free from substances that will cause taste or odor in edible aquatic life, or that will cause turbidity or color in such amounts as to reduce the depth of the compensation point for photosynthetic activity by more than 10 percent or to reduce the visibility of a Secchi disc more than 10 percent. Toxic Substances: Free from substances in concentrations that will be toxic to aquatic life after reasonable mixing. Wastes shall not contain substances that will bioaccumulate in aquatic life to levels that will be harmful to human health. Floating Solids, Oil and Grease: Free from floating solids, oil and grease of petroleum origin. Temperature: Not to exceed 1°F change from natural temperature. Nutrients: Not to exceed amounts that will cause objectionable growths of algae or other aquatic life.
Maryland	6.0-9.0 (unless natural)	—	100°	—	4.0 (unless naturally lower)	Color, Taste and Odor: Free from wastes that produce taste or odor in such degree as to create a nuisance or render any undesirable taste to fish flesh or other edible aquatic products, or that are toxic to fish or other aquatic life. Turbidity: Free from settleable solids and floating debris. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Massachusetts	6.0-9.0	--	90°	—	5.0	Color, Taste and Odor: Free from wastes that produce taste or odor in such degree as to create a nuisance or render any undesirable taste to fish flesh or other edible aquatic products, or that are toxic to fish or other aquatic life. Turbidity: Free from settleable solids and floating debris. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.

MONS 219724

Water quality standards

	pH Allowable Range	Temperature (°F) Allowable Increase above ambient	Maximum	Dissolved Oxygen Minimum (mg/l)	Other Requirements
Michigan	6.5-8.5	0.5	--	10	[illegible] to be free from substances attributable to municipal, industrial or other discharges in such quantities as to cause taste and odor in the water or fish flesh or to cause [illegible] Color, taste and odor shall be [illegible] Solids, floating materials, [illegible] Toxic Substances [illegible] would injure the multiplication and growth of fish and other aquatic life Toxic Substances [illegible] to produce growths less than those that are or may become injurious to fish life
Minnesota	6.0-9.0	--	86°	--	--	Color, Taste and Odor, Solids Free from matter that causes nuisance conditions such as unnatural color, odors, [illegible] settleable solids, oil or sludge deposits
Mississippi	6.0-8.5	1.0	93°	10°	3.0	Color, Taste and Odor Free from substances that produce color or odor in such concentrations that [illegible] Settleable solids must not exceed 1.5 ml/l [illegible] mg/l Must be free from [illegible] which will produce [illegible] Toxic Substances [illegible] concentrations or combinations detrimental to human, animal or aquatic life
Missouri	6.5-9.0	--	90°	9° (average of cross section)	4.0°	Radioactivity Gross beta 1000 pc/l [illegible] Radium 226 3 pc/l Strontium 90 10 pc/l Turbidity [illegible] Waters must not cause [illegible] or bottoms of streams or interstate waters [illegible] Dissolved Gas [illegible] Solids No increase [illegible] Toxic Substances Concentrations not [illegible] to industrial use or toxic to humans, fish, wildlife 7.12
Montana	6.5-9.5	0.5	--	No adverse change	--	Radioactivity Not to exceed 60 PHS Drinking Water Standards Turbidity Must not increase [illegible] Color, Taste and Odor [illegible] Solids [illegible] Toxic Substances Amounts present must not [illegible] other industrial use
Nebraska	6.5-9.0	1.0	90°	5° (May-Oct.) 10° (Nov.-Apr.) Rate, 2°/hr.	5.0	Radioactivity Must conform with Radiological Health [illegible] Turbidity Color, Taste and Odor [illegible] 10% increase above natural ppm Color [illegible] Taste and Odor [illegible] Solids [illegible] 1,500 mg/l [illegible] Toxic Substances [illegible] from any point source [illegible] Industrial Use [illegible]
Nevada	[illegible]	--	77°F (5 miles) 57°F (mixing zone)	--	5.0 6.0 (winter, June-Sept.)	Radioactivity Limited to 1/10 of the [illegible] Turbidity Color, Taste and Odor [illegible] Solids [illegible] Toxic Substances [illegible] Industrial Use [illegible]
New Hampshire	[illegible] (no thermal)	--	80°F	No measurable [illegible] Not to exceed 1/2 of the [illegible]	5.0	Turbidity Color, Taste and Odor [illegible] Solids [illegible] Toxic Substances [illegible]
New Jersey	[illegible]	--	83°F (mixing zone)	5° (up to 67°)	4.0°	Turbidity [illegible] Not noticeable in water [illegible] Color, Taste and Odor [illegible] Solids [illegible] Toxic Substances [illegible]
New Mexico	[illegible]	--	--	Not [illegible] [illegible]	[illegible]	Radioactivity [illegible] Turbidity [illegible] Color, Taste and Odor [illegible] Solids [illegible] Toxic Substances [illegible]
New York	[illegible]	--	86°	[illegible] 5/24 hrs	4.0	[illegible]

MONS 219725

	pH	Allowable Temp. Increase (F)	Max. Temp. (F)	Dissolved Oxygen (mg/l)	Other Requirements
North Carolina	[illegible] for Ca. [illegible] & Wa. as for a. 4 sm. swamps	—	95°	3.0	Color, Taste and Odor Free from wastes [illegible] Toxic Substances [illegible] industrial wastes
North Dakota	6.0-9.0	0.5	93°	10°	3.0 5.0 (for 16 hrs./day)	Radioactivity: No discharge allowed unless [illegible] Color, Taste and Odor: [illegible] Toxic Substances: [illegible]
Ohio	6.0-9.0	—	95°	—	3.0 7.0 (1.5 average)	Color, Taste and Odor Free from [illegible] Toxic Substances: [illegible]
Oklahoma	6.5-8.5	—	93°	5°	4.0	Radioactivity: [illegible] Color, Taste and Odor: [illegible] Toxic Substances: [illegible]
Oregon	6.5-8.0	—	—	2° (mixed water 70° test)	5.0	Radioactivity: [illegible] Color, Taste and Odor: [illegible] Toxic Substances: [illegible]
Pennsylvania	6.0-8.0	—	93°	2°/hr.	4.0 5.0 (daily average)	Color, Taste and Odor: [illegible] Toxic Substances: [illegible]
Rhode Island	6.0-8.5	—	—	4°	3.0* 5.0* (16 hrs./day)	Radioactivity, Toxic Substances: [illegible] Color, Taste and Odor: [illegible] Solids: [illegible]
South Carolina	6.0-8.5 6.0-8.5 (swamps)	—	93.2**	10°*	3.0* 2.5* (swamps)	Turbidity, Color, Taste and Odor: Free from [illegible] Toxic Substances: [illegible]
South Dakota	6.0-9.5	1.0	—	—	—	Radioactivity: [illegible] Color, Taste and Odor: [illegible] Toxic Substances: [illegible]
Tennessee	6.0-9.0	1.0 (24 hrs.)	93°	10° Mole 4°/hr.	Low enough to [illegible] concentrations	Radioactivity: [illegible] Color, Taste and Odor: [illegible] Toxic Substances: [illegible]
Texas	[illegible] (Coastal Waters)	—	—	—	4.0	Radioactivity: [illegible] Color, Taste and Odor: [illegible] Toxic Substances: [illegible]

Water quality standards

	pH Allowable Range	pH Allowable Deviation	Temperature (°F) allowable Maximum	Temperature (°F) allowable Increase above natural	Dissolved Oxygen (ppm) Minimum	Other Requirements
Utah	6.5-9.0	—	—	—	—	Radioactivity shall not exceed [illegible] Color No [illegible] or color [illegible] Taste and Odor [illegible] Floating [illegible] Toxic Substances [illegible]
Vermont	6.0-8.5	—	—	4°	3.0* 5.0* (16 hrs / day)	Radioactivity [illegible] Turbidity, Color, Taste and Odor [illegible] Deposits or solid [illegible]
Virginia	5.0-9.0 (seasonal as low as 4.5)	—	85°* (unless naturally higher)	No sudden temperature changes that could harm aquatic life	1.0* 2.0* (daily average)	Color, Taste and Odor. No wastes that change existing color or produce odor to such a degree as to create a nuisance or be detrimental to the most sensitive type of use. Solids. No floating materials in amounts sufficient to be unsightly or create a nuisance or other [illegible] form unsightly [illegible] substances into waters in concentrations or combinations that would interfere directly or indirectly with industrial use
Washington	6.5-8.5	0.5	70°	t = [110/(T+15)]*	6.5 or 70%*	Radioactivity. Toxic Substances. Deleterious materials that would adversely affect [illegible] Turbidity. [illegible] over natural [illegible] Color, Taste and Odor. Solids. [illegible] suspended floating or submerged matter shall not reduce esthetic values so as to affect industrial use
West Virginia	Process water 5.5-9.0 Cooling water 5.0-9.0	—	Cool water 90° (May-Nov.) *3° (Dec.-Apr.) Process water must permit fish passage	5° (Tale 7°/Fe (See Apx.)	—	1.0 2.0 (daily average)	Color. None that is objectionable. Taste and Odor. [illegible] able odors in vicinity of the water. Solids. [illegible] floating settleable or suspended solids of unsightly nature or quantity [illegible] Toxic Substances. [illegible] concentrations of materials poisonous to human, animal or fish life
Wisconsin	6.0-9.0	0.5	89°	—	1.0 2.0 (daily average)	Color, Taste and Odor. [illegible] or odor in amounts [illegible] solved solids must not exceed [illegible] [illegible] Toxic Substances. [illegible] that would create a [illegible] a nuisance. Taste Substances. [illegible] limitations toxic to humans or [illegible]
Wyoming	6.5-8.5	—	—	4° 2° (for streams where temp. not over 70°)	6.0	Radioactivity. [illegible] Turbidity. No more than 15 JCU [illegible] is 150 JCU or less [illegible] Color. Essentially free of substances [illegible] [illegible] Toxic Substances. [illegible] substances or concentrations or combinations [illegible] animal or aquatic life

* Standard reserve [illegible] from Federal Water Pollution Control Administration approval.

This reprint is an excerpt from the "Plant Sites '69" report that appeared in the October 5, 1968 issue of CHEMICAL WEEK

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MONS 219727

Monsanto Co.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

February 18, 1970

Dear Sir:

Recently several newspaper and magazine articles have been published indicating that Polychlorinated Biphenyls (PCBs) have been found covered at some point in some marine, aquatic and wildlife environments. The quantities detected are said to be in the parts per million and parts per billion categories.

It is claimed that the PCBs found strongly resemble chlorinated biphenyls containing 54% and 60% chlorine by weight. Products which are sold by Monsanto under the trade names of Aroclor® 1254 and 1260 do contain chlorinated biphenyls. In addition to Aroclor® 1254 and 1260, Monsanto sells certain functional fluids containing Aroclor® 1254. These include Pydraul® 625, Pydraul® AC, Pydraul® AC - Water Grade, Pydraul® 540, Therminol® FR-3 and certain dielectric formulations. Several other companies around the world also produce products containing chlorinated biphenyls.

As your supplier of Aroclor® 1254 and 1260 and formulated products containing 1254, we wish to alert you to the potential problem of environmental contamination as referred to in the newspaper and magazine articles.

We would like to point out the following additional facts:

1. Products such as Pydraul® 90, 135, 230, 312, A-200, F-9, 150, and 60, Turbinol® 153 and Therminol® FR-1 and FR-2 are not formulated with Aroclor® 1254 or 1260.

2. PCBs with a chlorine content of less than 54% have not been found in the environment and appear to present no potential problem to the environment.

MONS 219728

We have developed and are now testing new formulations to replace the Aroclor® 1254 and 1260 components of our hydraulic® products. These new products appear to be equal in performance and to have similar physical properties.

We feel that all possible care should be taken in the application, processing and efficient disposal of these products to prevent them becoming environmental contaminants. Of interest to you may be an article in Chemical Week October 29, 1969, regarding water pollution standards set by each state in the Union. It is attached. This article reflects that good manufacturing practice in the future may require that no product used by any company should find their way into waterways.

We realize that you have marketed or may now market transformers and other electrical equipment containing dielectric fluids which include Aroclor® 1254 and 1260. Although these fluids are sealed into such equipment it is recognized that occasionally the fluid may be lost through leaks resulting from equipment misuse or equipment repair necessitating replacement of the fluid. Since the dielectric fluid contained in this equipment is only an incidental part of the over-all unit manufactured by you, we are not notifying the purchasers of such equipment of the potential environmental contamination problem described in this letter. We do recommend, however, that you notify such equipment users of this problem.

Sincerely yours,

Donald A. Olson
Director of Sales
Functional Fluids Group

lb

Attachment

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

Feb [illegible]
27

Dear Customer:

Recently several newspaper and magazine articles have been published indicating that Polychlorinated Biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. The quantities detected are said to be in the parts per million and parts per billion categories.

It is claimed that the PCBs found strongly resemble chlorinated biphenyls containing 54% and 60% chlorine by weight. Products which are sold by Monsanto under the trademarks of Aroclor® 1254 and 1260 contain chlorinated biphenyls.

As your supplier of Aroclor® 125[illegible], and 1260, we wish to alert you to the potential proble[illegible] of environmental contamination as referred to in the newspaper and magazine articles.

We would like to point out the following additional facts.

1. Certain Monsanto products which are sold under the Aroclor® trademarks, namely Aroclor® 5060, 5442 and 5460, are not polychlorinated biphenyls.

2. PCBs with a chlorine content of less than 54% have not been found in the environment and appear to present no potential problem to the environment.

MONS 219730

We feel that all possible care should be taken in the application, processing and effluent disposal of these products to prevent them becoming environmental contaminants. Of interest to you may be an article in Chemical Week, October 29, 1969 regarding water pollution [illegible] by each state in the Union. It is attached. This article reflects the view that good manufacturing practice in the future may require that no products used by any company be lost or discharged in such a manner as to ultimately be found in waterways.

Very truly yours,

W. E. Schalk
Director of Sales
Plasticizers

ek

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

May 1, 1970

Dear Customer:

You have received our letter mailed February 27, 1970 notifying you of the allegations that certain polychlorinated biphenyls (PCBs) had been found in the environment and were contaminants. Since that time, other reports concerning PCBs have been published. An examination of the PCB matter has indicated that their use in synthetic resin compositions may be a source of the alleged environmental contamination.

Monsanto has sold PCB-containing materials under the trade name of Aroclor®. These Aroclors® included:

Aroclor® 1232
Aroclor® 1242
Aroclor® 1248
Aroclor® 1254
Aroclor® 1260
Aroclor® 1262
Aroclor® 1268
Aroclor® 4465
Aroclor® 1100 Series
Montar® 1

Toluene or xylene blends of the above products also contained PCB.

In review of the allegations which have been made concerning PCBs, and being a concerned and responsible member of the world community, we have come to a decision to discontinue the sale of PCB-containing products for modifier and plasticizer applications effective August 30, 1970.

Recognizing that this action will result in research effort on your part to find adequate replacements, we have prepared a series of data sheets outlining suggested alternatives for most applications. Copies of the report for your apolication may be obtained by calling the regional office closest to you as shown on the attached sheet.

We urge that you consider initiating now any necessary work on your part to effect the change to a new material. We stand ready to assist you in any way possible.

Very truly yours,

W. E. Schalk
Director of Sales
Plasticizers

/dbw

Attachmert

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone 314/694-1000

June 8, 1970

Dear Sir:

On February 9, 1970, we advised you by letter that several newspaper and magazine articles had been published indicating that polychlorinated biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. Products such as our Therminol FR series do contain chlorinated biphenyls. These products are:

Therminol FR-Lo Temp
Therminol FR-0
Therminol FR-1
Therminol FR-2
Therminol FR-3

In view of the fact that PCB has been found in the environment, there is a possibility that the Food and Drug Administration may place a maximum limitation on the quantity of PCB in food.

With these circumstances in mind, we have reviewed the applications in which Therminol FR heat transfer fluids are used. The application of Therminol FR fluids in food processing, such as to cooking oils for food preparation and to edible oils in deodorizing processes, does appear to present a potential source for contaminating food products with PCBs. Because of these factors, we feel it is in your interest as well as ours to use a different heat transfer fluid in your systems for these food related to edible materials. Accordingly, we wish to inform that after July 31, 1970, Monsanto will no longer sell Therminol series fluids in applications where the potential for food contamination exists.

MONS 219734

We encourage you to change your heat transfer fluid shortly or contact your Monsanto representative for assistance. We also you change to our Therminol 60 heat transfer fluid. We could work with you on this alternative and also on disposal of your FR fluid.

In contemplating a change to this fluid, or any other, it is also suggested that you contact the insurer of your property for evaluation of any effects that may have on your insurance status.

If we can be of assistance please call on us.

Cordially,

John R. Fallon

John R. Fallon
Marketing Manager
Heat Transfer Fluids

/dn

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

June 11, 1970

Dear Sir:

You have received our letter mailed on February 27, 1970, notifying you of the allegations that certain polychlorinated biphenyls (PCBs) had been found in the environment and were contaminants. Since that time other reports concerning PCBs have been published. An examination of the PCB matter has indicated that their use in certain applications may be a source of the alleged environmental contamination. Monsanto has sold PCB-containing materials for industrial use under the trade name of Aroclor®. In view of the allegations which have been made concerning PCBs, and being a concerned and responsible member of the community, we have come to a decision to discontinue the sale of PCB-containing products for industrial applications effective August 30, 1970. The products concerned are Aroclor® 1242, Aroclor® 1246, Aroclor® 1254 and Aroclor® 1260.

Recognizing that this action may cause you some inconveniences, we suggest you contact our local representative to discuss your applications. We may be able to suggest possible replacement products for your application.

Very truly yours,

Donald A. Olson
Director of Sales
Functional Fluids Group

lb

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

June 11, 1970

Dear Customer:

In February we advised you of the newspaper and magazine articles indicating that polychlorinated biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments and might be environmental contaminants. It was claimed that the PCBs found strongly resembled chlorinated biphenyls containing 51% and 60% chlorine by weight.

Pydraul 625, Pydraul AC, Pydraul AC Winter Grade and Pydraul 540 have historically been formulated with these polychlorinated biphenyls. New formulations have now been developed and tested. These replacement products provide equal or superior performance. The new formulations will be designated Pydraul 625-A, Pydraul AC-A, Pydraul AC-A Winter Grade and Pydraul 540-A. These formulations are completely compatible with the old formulations.

During the next 90 days, as inventory is depleted in warehouses around the country, the new formulations will be shipped to fill your orders. After this period, we will market only the newly formulated products.

We thank you for your consideration in this matter. If we can be of further assistance or answer any questions you might have please contact our local representative who can provide additional technical information about the new formulations or contact me in St. Louis.

Very truly yours,

W. T. Johnson

W. T. Johnson
Marketing Manager
Industrial Fluids

15

Monsanto

ORGANIC CHEMICALS

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

August 14, 1970

Dear Customer

Dear Sir:

You have received our letters of February 27, 1970 and June 1, 1970 covering Monsanto's withdrawal of polychlorinated biphenyls (PCBs) from the market. The February 27 letter reviewed some of the potential hazards of PCBs and of environmental polution in general. The June 1 letter announced that we were withdrawing all polychlorinated biphenyls used as plasticizers or modifiers from the market, and that the last shipment of these materials would be made August 30, 1970.

In as much as you may have some inventory of these materials which you might be planning to use during the period in which you change over to other products, we felt it imperative to inform you of the latest information concerning PCBs.

It was recently brought to our attention that the Food and Drug Administration has apparently established guidelines setting forth suggested maximum levels of PCBs allowable in certain foods. These levels, as we understand them, are 5 parts per million in fish and 0.2 parts per million in milk. Monsanto, therefore, strongly recommends that PCBs not be used in applications which could lead, either directly or indirectly, to the contamination of food or water supplies for humans or animals. Examples of applications which would seem particularly hazardous would be coatings for water treatment facilities, coatings for food handling equipment, or coatings for such farm items as silos and feed hoppers.

It has recently come to our attention that PCBs have been found in cows milk. This adds emphasis to Monsanto's recommendation that PCBs not be used in any application where they might come in contact with or otherwise contaminate food, silage, water supplies, etc.

The latest available bulletin on our line of Aroclors is enclosed for your use. This publication replaces and supercedes bulletin O/PL-306 - Aroclor Plasticizers. The only products listed which will be sold after August 31, 1970 are 1) Aroclor 1221, a monochlorinated biphenyl which is readily biodegradable, and 2) Aroclors 5442 and 5460, both chlorinated terphenyls which have not shown themselves to be environmental contaminants. Please pay special attention to the section of this bulletin which relates to environmental hazards.

In addition to the products listed above which will remain on the market, Monsanto will sell a series of blends of Aroclor 1221 and Aroclor 5460 which will replace the polychlorinated biphenyls for many applications.

During this withdrawal of PCBs from the market, Monsanto has had in effect a modified returned goods policy stating that unopened containers less than one year old could be returned for full credit through July 31, 1970. From August 1 through August 31, 1970, 90 percent credit would be allowed. From September 1 through December 31, 1970, 50 percent credit would be allowed. The customer will pay all return freight. All of the dates in the time schedule for this returned goods policy are hereby extended an additional two months.

Monsanto realizes that the removal of these products from the market has caused a great deal of concern and expense for our customers. This is certainly regrettable. However, it appears to us that as a responsible supplier, this is the only reasonable course of action. We stand ready to assist you as we can with your reformulation work.

Very respectfully,

Walter E. Schalk
Director of Sales
Plasticizers

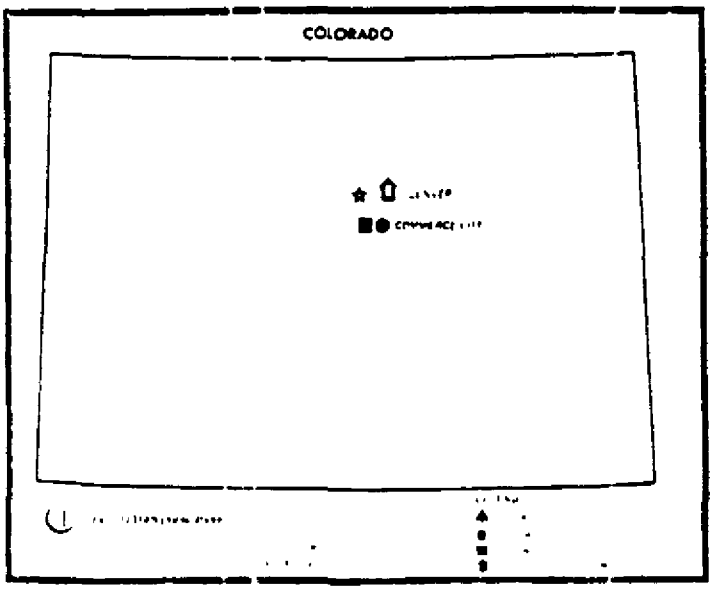
VERNON

Los Angeles County

CONTAINER CORP. OF AMERICA, Sub. of Marcor Inc.
(Exec offices in Chicago, IL)
2001 E 55th St
Vernon CA 90058
PHONE 213 583 3421
RAILROADS SP
PERSONNEL G W Cran Gen Mgr
E Constantor Plant Mgr
J Solgerson Plant Eng
Leo Hoffman Tech D
L V Peterson Plant Cont
PAPER/BOARD CAPACITIES Total paper/board capacity 350 tpd, boxboard 100 tpd, corrugating medium 250 tpd
PAPER/BOARD PRODUCTS Box board, gaskmt coated board, can stock, core stock & cores, chipboard, match book, tub stock
PAPER/BOARD MILL DATA
Pulpers 5 hydropulpers
Refiners 5
Jordans 5
Paper machines 2 (1 fourdrinier 180" width 158" trim, design speed 1 200 fpm, yr installed 1968, 1 cylinder 96" width 85" trim, speed 600 fpm)

FLINTKOTE CO., THE, Pioneer Bldg Prods.
(Exec office in Stamford CT)
5500 S Alameda St
Vernon CA 90058
Mailing address Box 2218 Terminal Annex Los Angeles CA 90051
PHONE 213-583-3011 Telex 69E209
RAILROADS SP
HIGHWAYS U S 101 I 5
PERSONNEL Wilson Harvey Gen Mgr
August C Costa Chief Eng
Bert Scandelle Pur Dir
C H Catering Dir Trai
W C Brady Tech Serv Mgr
James Stanfield Plant Pers Mg
Richard Berns Safety Eng
John Vershel Mill Mgr
Garrett Jenson Mill Supt
Bill J Abue Asst Supt Tech
A Solzer Chief Insp
M Zormeno Shift Fore
J Dunlop Shift Fore
D Morrison Shift Fore
E Gonzalez Shift Fore
Ronald Grinman Beater Rm Fore
Antonio Bernal Lab Fore
George Roesler Maint Mgr
A Solzer Inst Chief
John Van Dunsem Consult
Paper mill employees 266 (total no employees at this location 700
PULP GRADES & CAPACITIES Total pulp capacity 405 tpd, deinked wood 30 tpd secondary fiber 375 tpd
PAPER/BOARD CAPACITIES Total paper/board capacity 350 tpd paperboard 180 tpd, corrugating 118 tpd
PAPER BOARD PRODUCTS Felt gypsum liner board, roofing
PAPER/BOARD MILL DATA
Pulpers 8 (5 Sharple hydropulpers 1 Morden 1 Sharple Hi-Density 1 Bolton Emerson)
Beaters 2 1 500 lb Hollander
Refiners 7 (5 = 4 Miami 2 Sprout Waldron)
Jordans 12 (9 Miami 3 Emerson)
Screens 7 (3 Centrisorter 150T cpy ea., 4 Jonsson 35T cpy ea.)
Stock cleaning system 3 250T
Paper machines 3 (3-cylinder 110" width 106" trim speed 450 fpm yr installed 1937 0 cylinder 122" width 112" trim speed 350 fpm installed 1924 1-cylinder 122" width 112" trim speed 325 fpm installed 1942)
Can dryers 275
Other type dryers 3 direct gas fired
Calender stacks 5
Winders 3
Rewinders 4
Cutters 3 (120" 114" width on machine, 50" width off machine)
Trimmers 3 (84" 50" 90" width)
Roll handling equipment
Cranes 3 overhead
Elevators 3
Trucks 3
POWER PLANT/WATER & WASTE DATA
Fuel used Gas consump 4 071 000 Btu/day, oil
Steam generated 200 000 lb/hr
Electricity consump 105 000 kwh
Amount purchased 100 %
Water consump 1 3 mil gpd
Source 3 wells

PACIFIC PACKAGING CORP
4444 Pacific Blvd
Vernon CA 90058
PHONE 213 587 5121
PERSONNEL A F Landsberg Board Chm Mgr
PAPER/BOARD CAPACITIES Total paper/board capacity 180 tpd
PAPER/BOARD PRODUCTS Box board, chip board, tote board
PAPER/BOARD MILL DATA
Pulpers 7 600 tpd
Refiners 1 150 tpd
Jordans 13 200 tpd
Paper machines 2 cylinder (90" width 83" trim speed 310 fpm, 112" width 104" trim speed 350 fpm)
Can dryers 164
Rewinders 3
Gloss calender 1
Calender stacks 4
Cutters 3 (83" width 80 tpd, 104" width 125 tpd, 50" width 20 tpd)
Trimmers 3 (1 110" 2 86" width)
Coating equipment
On machines 1 airknife
Roll handling equipment
Cranes 4
Elevators 2
Trucks 4
Other lyde trucks 1 grab, 12 fork
POWER PLANT/WATER & WASTE DATA
Fuel used Gas consump 8 4 million Btu/day
Power boilers 3 combination 270 000 lbs/hr
Steam generated 260 000 lbs/hr
Electricity consump 13 000 kwh
Amount purchased 100%
Water consump 1 7 mil gpd
Source Wells 100%
Effluent System
Clarifiers 1
Sludge System



COLORADO

COMMERCE CITY

Adams County

PACKAGING CORP OF AMERICA, Div. of Tenneco Inc
(Exec offices in Evanston IL)
5501 Brighton Blvd
Commerce City CO 80216
PHONE 303 297 7 30
RAILROADS DRGW
HIGHWAYS Colo 265
PERSONNEL Hart, Harold W Mgr
E L Crawford Supt
Paper mill employees 98 (total employees at this location 68
PAPER/BOARD CAPACITIES [illegible]
PAPER/BOARD PRODUCTS [illegible]
PAPER/BOARD MILL DATA
Pulpers 3 (2 continuous 1 batch 30 tpd
Refiners 3 batch
Beaters 2 1 10 lbd
Jordans 1
Screens 1 [illegible]
Paper machines 1 [illegible]
Can dryers [illegible]
Calender stacks 2

MONSANTO

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

August 27, 1970

Dear Sir:

In February we advised you of the newspaper and magazine articles indicating that polychlorinated biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. It was claimed that the PCBs found strongly resembled chlorinated biphenyls containing 54% and 60% chlorine by weight. The quantities detected are said to be in the parts per million and parts per billion categories.

Pydraul F-9 has been formulated with polychlorinated biphenyls. A new formulation has been developed and tested to provide equal or better performance. The new formulation will be designated Pydraul F-9-A. This formulation is completely compatible with the old formulation and does not contain polychlorinated biphenyls.

During the next 90 days, as inventory is depleted in warehouses around the country the new formulations will be shipped to fill your orders.

If we can be of further assistance or answer any questions you might have please contact our local representative or me in St. Louis.

Very truly yours,

Norman T. Johnson
Marketing Manager
Industrial Fluids

lb

3

MONS 219741

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

October 26, 1970

Gentlemen:

As a supplier of vacuum pump fluids, namely Santovac I and Santovac II, which do contain polychlorinated biphenyls (PCBs) we wish to inform you that the FDA announced a guideline for PCBs of 5 ppm in fish and 0.2 ppm in milk.

Therefore, control of waste and spills is imperative. In no case should the material be discharged directly to streams.

Used Santovac I or Santovac II should be reclaimed for continuous recycle or returned to Monsanto for disposal. There will be a slight service charge plus freight costs for disposal.

Products previously used for diffusion ejector pumps such as Aroc or 1242, Aroclor 1248 and Aroclor 1254 are no longer offered for sale. Santovac I has replaced Aroclor 1242 and Aroclor 1248. Santovac II has replaced Aroclor 1254. The replacement products are direct replacements, fully miscible and no qualification testing should be needed.

For further information please contact myself or the nearest Monsanto sales office. Santovac is not included in the PCB chemistry and no special precautions on handling are necessary

Sincerely,

David Hall

David Hall

lb

MONS 219742

Monsanto

ORGANIC CHEMICALS DIV

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

February 1, 1971

Dear Sir:

In February, 1970, we advised you of the newspaper and magazine articles indicating that polychlorinated biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. It was claimed that the PCBs found strongly resembled chlorinated biphenyls containing 54% and 60% chlorine by weight. The quantities detected are said to be in the parts per million and parts per billion categories.

Pydraul 312, Pydraul 135, Pydraul 230, Pydraul 540-A and Pydraul A-200 have been formulated with polychlorinated biphenyl. New formulations have been developed and tested to provide equal or superior performance. The new formulations will be designated Pydraul 312 A, Pydraul 135 A, Pydraul 230 Pydraul 540 B and Pydraul A-200-B. They are completely compatible with the old formulations and do not contain polychlorinated biphenyls.

During the next 60 days, as inventory is depleted in warehouses around the country, the new formulations will be shipped to fill your orders.

If we can be of further assistance or answer any questions you might have, please contact your local representative or me in St. Louis.

Very truly yours,

C L Bradford

C. L. Bradford
Product Manager

lb

MONS 219743

Monsanto

Monsanto Company
800 N Lindbergh Boulevard
St Louis Missouri 63166
Phone (314) 694-1000

April 15, 1971

Dear Sir:

Over the past year or so we have written you several letters concerning polychlorinated biphenyls and have urged that care be taken to prevent the escape of hydraulic fluids containing PCBs into the environment. Certain Pydraul hydraulic fluids did contain PCBs, taking advantage of the excellent characteristics of that material for certain industrial applications. However, in view of the questions which have been raised concerning possible environmental effects, Monsanto launched a program to develop alternative products without using PCBs.

This is to inform you that our efforts to develop alternative hydraulic fluids for applications which cannot be completely confined have been successful. There are now no PCBs in any of our Pydraul fluids.

We appreciate your understanding over this past year. The reformulated products you are now using will give you equal or better performance than you previously had - and with no PCBs.

Very truly yours,

C. Larry Bradford

C. Larry Bradford
Product Manager
Hydraulics & Lubricants

P. S. - Would you please circulate this letter to all departments in your operation that are concerned with hydraulic fluids and/or maintaining a clean environment.

MONS 219744

Monsanto

Monsanto Company
800 N Lindbergh Boulevard
St Louis Missouri 63166
Phone (314) 694-1000

Aug 6, 1971

August 1971

Gentlemen:

We are contacting your firm as a manufacturer of equipment which may contain one or more of the Therminol©FR series heat transfer fluids. Therminol©FR series includes Therminol© FR Lo-Temp, Therminol©FR-0 and Therminol©FR-1. As you are probably aware, the Therminol©FR series contains polychlorinated biphenyls (PCB) of various types.

As you are undoubtedly aware, the PCB concentration in our environment has increasingly come under the scrutiny of various governmental agencies and scientific laboratories. In some studies, certain PCBs have been found to be persistent, an environmental contaminant and, possibly, injurious to certain forms of bird, aquatic and animal life. Accordingly, it is very important that PCBs be kept out of the food chain.

Effective immediately, we are instituting a policy of restricting sales of the Therminol©FR series to existing heat transfer systems which are presently utilizing the Therminol©FR series and do not involve food or food related products. We would appreciate your discontinuing the use of the Therminol©FR series in any new equipment sales and discontinuing any recommendation of the Therminol©FR series in your literature. In accordance with this policy, the Therminol©FR series will no longer be available to your firm.

We would like to point out, however, that certain Monsanto products which are sold under the Therminol© trademark, namely, Therminol©55, 66, 77 and 88 do not contain PCBs and will continue to be available for new heat transfer systems as well as for replacements of existing systems. While these are not classified as fire-resistant, proper design, operation and maintenance and the use of appropriate protective devices should minimize any added fire risks. We would appreciate your continued use

11

and recommendation of Therminol©55, 66, 77 and 88 in both new and existing systems.

Should you have any questions, please contact your local Monsanto representative or me.

Sincerely,

J. J. Roder

J. J. Roder
Product Supervisor
Heat Transfer Fluids

cs

Monsanto

ORGANIC CHEMICALS DIVISION

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

September 30, 1971

Direct Customer

Dear Sir:

As you may recall, on August 31, 1970, Monsanto terminated sales of polychlorinated biphenyls (PCBs) as plasticizers and resin modifiers because it appeared that these products might be associated with some problems in the environment. Monsanto is now selling a line of non-PCB plasticizers under the same trade-name - Aroclor® - as was used in the past. This letter is intended to eliminate any confusion which might result from the fact that this trade-name has been used on both PCB and non-PCB products.

Our Aroclor® product line is now made up of polychlorinated terphenyls, monochlorinated biphenyl, and blends of these products. None of these materials has been shown to create any environmental problems. On the other hand, Food and Drug Administration approval has not been obtained for any of these products. Accordingly, the Aroclor® plasticizers should not be used in connection with food or food-related products, with food wrapping or food container materials. Further, Monsanto strongly recommends that these products not be used in any other application such as non-FDA regulated food systems, in potable water systems, in any animal feeding systems, or in pharmaceuticals.

Very respectfully,

W. E. Schalk

W. E. Schalk
Director of Sales
Plasticizers

/dbw

MONS 219747

bcc C. [illegible]
1000 D. [illegible]
5120 J. A. [illegible]

October 26, 1971

Mr. R. Courtney
Ridgeway Lithograph
4111 [illegible] Ave. N.E.
Redmond, Wash. 98052

Dear Mr. Courtney:

This letter concerns the conversion of your heat transfer unit from Therminol FR to Therminol 55

Literature on Therminol 55 is enclosed. We are arranging for two drums of Therminol 55 to be sent to your attention at no charge. You should drain the Therminol FR from your system thoroughly -- this means removing all of the FR fluid. Therminol 55 can then be added and operation of the system resumed.

We would like to remind you that Therminol 55 is not classified as a fire resistant heat transfer fluid. Consequently, you [illegible] wish to consider the use of protective devices to minimize any added fire risks. We suggest that you consult with the [illegible] of your property relative to this matter.

Also enclosed are labels to be placed on the containers of drained FR fluid for return to the address shown. We will pay the return freight.

Your cooperation is appreciated.

Sincerely,

D. F. Roush
Product Specialist
Heat Transfer Fluids

cs
Enclosures

Note to bcc Application is pattern waxer for margarine [illegible]. Initially used [illegible], but switched to [illegible] cause of sludge problems.

MONS 219748

MONSANTO COMPANY
Department 246
SAUGET, ILLINOIS 62201

MONS 219749

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

As we have previously notified you by way of correspondence since early 1970, the material described on the attached acknowledgement of your order contains polychlorinated biphenyls (PCB). Polychlorinated biphenyls are highly stable chemical compounds and are not readily biodegradable. Therefore, when placed in the environment they may be considered contaminants and may adversely affect some species of animal and marine life.

You must take every precaution to prevent any entry of polychlorinated biphenyls into the environment through spills, usage, leakage, disposal, vaporization or otherwise.

This material should not be used by you or your customer in equipment, packaging materials or products involved in the processing, handling, or storage of food, food related products, animal feeds, food wrapping or container materials, potable waters or pharmaceuticals.

Very truly yours,

Howard S. Bergen, Jr.
Director
Specialty Products Group

/jf

Attachment

MONS 219750

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

December 15, 1971

Dear Sir:

We are writing to advise you that, effective this date, Monsanto will no longer sell the Therminol® FR series of heat transfer fluids. This important decision by Monsanto's management has been carefully considered.

The Therminol® FR series of fluids contain polychlorinated biphenyls (PCBs). As we have previously advised you, studies indicate PCBs may be accumulating in the environment. In some instances, PCBs have been found in food or in the food chain. An article by Carl G. Gustafson of the Federal Water Quality Administration appearing in "Environmental Science & Technology" and dealing with this subject is attached for your information.

Because of Monsanto's concern over this problem, we have discontinued sales of PCBs where the usage was in so-called "open systems." We have discontinued sales of Therminol® FR materials where the usage would be in food processing applications. In addition, we have encouraged Therminol® FR fluid customers to switch to other materials.

As a result of these efforts, many of our heat transfer fluid customers have switched from Therminol® FR series fluids to other materials or systems.

Our action in discontinuing sales for use in heat transfer systems has been taken because of the problems which may arise should there occur accidental leakage of PCBs from such systems. We believe this action is in the best interest of all our customers who have continued using these materials in heat transfer applications.

In order to help you accomplish a change-over from Therminol® FR to another heat transfer fluid with the least difficulty, Monsanto will offer you the following special services:

1) We have assembled a team of experienced engineers who will be available to visit your plant on request to consult with you on available alternatives. Of course, the decision is and will be yours as to how you elect to proceed. If you consider such a service would be of assistance to you, please telephone (314) 694-2514, or write directly to Dr. Cumming Paton, Monsanto Company, P. O. Box 14617, St. Louis, Missouri 63178.

2) We will pay freight costs incurred in returning the Therminol® FR to us and will properly dispose of the material (by high temperature incineration) at our cost. We will contact you concerning instructions about drainage, drumming and shipping of material to our facility in St. Louis.

3) We will accept return of any unopened drums of Therminol® FR series products which may be in your possession and credit you for this material at full purchase price if returned to us prior to March 1, 1972.

We sincerely regret any hardship that this decision may cause you, but feel you will agree Monsanto has made the correct decision.

Yours sincerely,

Howard Bergen

Howard Bergen, Director
Specialty Products Group
Monsanto Industrial Chemicals Company

Attachments

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO
800 N Lindbergh Boulevard
St Louis, Missouri 63166
Phone (314) 694-1000

December 31, 1971

Dear Sir:

We are writing to advise you that, effective this date, Monsanto will no longer sell Santovac 1 and Santovac 2 vacuum pump fluids.

These two Santovac fluids contain polychlorinated biphenyls (PCBs). As we have previously advised you, studies indicate PCBs may be accumulating in the environment. In some instances, PCBs have been found in feed or in the food chain. An article by Carl G. Gustafson of the Federal Water Quality Administration appearing in "Environmental Science and Technology" and dealing with this subject is attached for your information.

Because of Monsanto's concern over this problem, we have discontinued sales of PCBs where the usage was in so-called "open systems". We have discontinued sales of Santovac 1 and Santovac 2 where the usage would be in food processing applications.

Our action in discontinuing sales for all uses in vacuum systems has been taken because of the problems which may arise should there occur accidental leakage of PCBs from such systems. We believe this action is in the best interest of all our customers who have continued using these materials in vacuum applications.

Please contact your pump supplier for his recommended replacement product.

To prevent entry of PCBs into the environment during your changeover from Santovac 1 or Santovac 2, return the used fluid to us for proper disposal (by high temperature incineration). Please send to Monsanto Co., W. G. Krummrich Plant, Sauget, Ill. 62201, Attention: Supervisor Dept. 246. To help you accomplish this with the least difficulty, we will pay the freight and disposal costs involved through April 1, 1972.

We will also accept return of any unopened cans or drums of Santovac 1 or Santovac 2 which may be in your possession and credit you at full purchase price if returned to us prior to March 1, 1972.

We sincerely regret any hardship that this decision may cause you, but feel you will agree Monsanto has made the correct decision.

Yours sincerely,

Howard L. Bergen

Howard Bergen, Director
Functional Products Group
Monsanto Industrial Chemicals Company

/pcp
Attachment

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

Feb 28, 1972

Dear Sir:

We are writing to advise you that Monsanto has adopted certain policies with respect to the further sale and delivery of all polychlorinated biphenyl (PCBs) products including those sold under tradenames such as Aroclor®, Inerteen®, Pyranol®, and under the generic term askarel.

Studies have indicated PCBs may be accumulating in the environment. In some instances PCBs have been found in food or in the food chain. Because of Monsanto's concern over this problem, we have discontinued sales of PCBs in all applications except as dielectric fluids for use in transformers, capacitors, and other electrical equipment and components. In the past, Monsanto has sold these fluids direct to transformer repair shops and to anyone requiring the fluid for top-up of an existing transformer. Monsanto has decided to discontinue direct sales to transformer repair shops and for transformer top-up. For your future requirements of dielectric fluids, we suggest you contact the manufacturer of the transformer for which you desire the fluid.

We sincerely regret any hardships that this decision may cause you, but it has been taken in an effort to continue to make available these products for important electrical applications. If you have any questions relative to this decision, please telephone (314) 694-2613, or write directly to Mr. Paul Bringnus, Monsanto Company, P. O. Box 14617, St. Louis, Missouri 63178.

Very truly yours,

T. L. Gossage
Marketing Director
Specialty Products Group

/bl

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone (314) 694-1000

March, 1972

Gentlemen:

In August, 1971 you were informed that the Therminol® FR series heat transfer fluids, namely FR Lo-Temp, FR-0 and FR-1 had been discontinued for all new systems. We did continue to supply the Therminol FR series heat transfer fluids into existing systems as makeup where we were assured that its use was in a non-food related system.

In a continuing effort to prevent any PCB from entering the environment, last December we notified our U.S. customers that the sale of all PCB-containing Therminols, namely Therminol® FR Lo-Temp, FR-0 and FR-1, was being discontinued. We are currently extending discontinuation world-wide. We are suggesting that these remaining systems be drained completely, flushed to remove PCB, and refilled with non-PCB fluids. The most likely Monsanto candidates would be Therminol 55 and Therminol 66. We are also asking that all PCB materials be returned to us for disposal.

In most cases this conversion can be accomplished with very little change to the system. It is important, however, to realize that the new fluids are not fire resistant and that protective devices may be necessary for these fluids just the same as for other combustible fluids. Suggestions regarding fire protection and other conversion details are included in the attached "Therminol Conversion" bulletin. We hope this will be helpful to you in answering any questions you receive as co-suppliers in Therminol FR systems.

We again want to ask your cooperation in this period of system conversions and appreciate your continued use and recommendation of the non-PCB containing Therminols, namely 55, 66, 77 and 88.

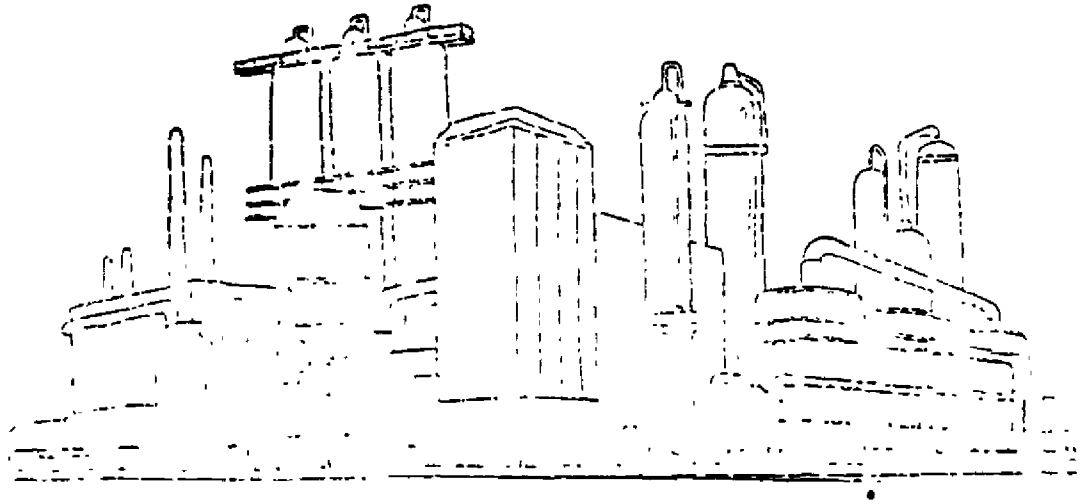
Should you have questions please contact your local Monsanto representative or me at this location.

Very truly yours,

J. J. Roder
Product Supervisor
Heat Transfer Fluids

cc
Enclosures:
Conversion Bulletin
Applications Unlimited

Inspection & Maintenance Guide



Attachment 5-2

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Section A
Transformer Askarel

I. Introduction

The term "askarel" as defined by IEEE, ASTM and the National Electrical Code generally describes a broad class of nonflammable synthetic chlorinated hydrocarbon insulating liquids widely used in transformers, reactors and accessory equipment operated at power frequencies. Askarels of various compositional types are in use. (For the general properties and types see ASTM D 2283.) Under arcing conditions the gases produced, while consisting of predominantly non combustible hydrogen chloride, can contain varying amounts of combustible gases depending upon the askarel type.

This manual describes the operating characteristics of transformer askarel liquid insulation and how it differs from mineral oil. Appropriate handling and disposal procedures for both scrap askarel liquid and impregnated solid materials are given in accordance with the guidelines recommended by the American National Standards Institute.

The information is based on facts gathered by Monsanto over 40 years as a producer of askarel, plus knowledge gained from the experience of transformer manufacturers and users. This guide outlines the very simple maintenance required for askarel fluid in "modern" transformers and offers suggestions for sealing and maintaining askarel in old units. By following this guide we believe users will obtain maximum service from askarel insulation with a reasonable minimum of maintenance. If questions arise relating to the designing and building of transformers, these should be referred to regular transformer suppliers.

Monsanto gratefully acknowledges the assistance, guidance and the contributions of certain data by the following:

- Edward L. Raab – General Electric
- Dr. T. K. Sloat – Westinghouse Electric

II. History of Trade Name Types

"Askarel" is the generic name for the non combustible liquid insulation and coolant first used by General Electric Company in 1929 for their Pyranol* brand name fire resistant transformers. Westinghouse Electric Corporation uses their brand name, Inerteen.**

Whatever the trademarked brand, the askarel contains chlorinated biphenyl – one of the [illegible] insulations developed by [illegible]. The inert material is [illegible] stable [illegible] non corrosive and has high dielectric strength under the [illegible] conditions encountered in transformers.

In addition to manufacturing Aroclor® (chlorinated [illegible]), Monsanto also mixes this dielectric fluid with chlorobenzenes [illegible] the presently [illegible] Inerteen and Pyranol blends described in Table I.

*Trademark of [illegible] Electric Company
**Trademark of Westinghouse Electric Corporation

®Aroclor is a trademark of Monsanto Company

Table I
The Composition of Transformer Askarels

	Method ASTM D2283		
	Type D	Type E	Type G*
Trade Names	Inertein 70 30	Inertein 100 42	Pyranol A1C3383
Ingredients (% by wt.)			
Aroclor® 1254 (pentachlorophenyl)	70	–	60
Aroclor® 1242, (trichlorophenyl)	–	100	–
trichlorobenzene	30	–	40
trichlorophenol	–	–	–
phenoxypropene oxide (scavenger, dipoxide scavenger)	0.18 to 0.22	0.18 to 0.22	0.115 to 0.135

*Method ASTM D2283 [illegible]

ASTM Method D 2283 titled "*Chlorinated Aromatic Hydrocarbons (Askarels) For Transformers*", also lists the composition of all transformer askarels used at various times since 1932.

Monsanto manufactures similar transformer askarel fluids in England where the trade name Pyroclor is used.

III. Interchangeability

In general all transformer askarels are interchangeable. However, it is suggested that the transformer manufacturer be consulted prior to mixing in significant proportions or total substitution.

IV. Official Transformer Askarel Shipping Specifications

The official shipping specifications for the three modern transformer askarel fluids are shown in Table II.

V. Ordering Instructions

Monsanto's current policy is to sell askarel transformer fluids only to transformer manufacturers. Others interested in these fluids should contact the manufacturers of askarel transformers and not Monsanto. The transformer name plate indicates the transformer maker and usually gives sufficient data to identify the specific askarel fluid used.

VI. Stability

Askarel fluid [illegible] is highly pure fire-resistant fluid made under [illegible] control to meet the shipping specifications as shown in Table II. It does not vary in composition like the commercial range of mineral oils.

Askarel insulation must never be mixed with mineral oil. Over two percent of mineral oil by volume in askarel begins to lower its fire [illegible].

[illegible] does not deteriorate when exposed to air, hot metal, it [illegible] long use to form conducting or corrosive [illegible] [illegible] severe electrical discharge.

In modern transformers the only real "enemy" of askarel is [illegible] by water. Keeping askarel water [illegible] will insure [illegible].

[illegible]

Official Transformer Askarel Shipping Specifications

Specification Properties	General Electric Co Transformer Pyranol Askarel 3 ASTM D2283 Type G*	Westinghouse Transformer Inerteen 70 ASTM D2283 Type D	Westinghouse Askarel Inerteen 30 ASTM D2283 Type E
Color, Saybolt	10 min	15 min	10 min
Appearance	Clear	Clear	Clear
Neutralization (max) ASTM D1534 Method A	30 max	30 max	25 max
Acidity (max) ASTM D1534	0.014 max	0.014 max	0.01 max
Dielectric strength at 60 cycles	35 KV min	35 KV min	35 KV min
Specific gravity at 25°C/25°C	4.7 to 4.9	4.2 to 4.5	4.7 to 4.9
Viscosity (SUS)			
Viscosity at 100°F (38°C)	100	100	100
Pour point (ASTM D1821 and Test Procedure 14.4)	0.10 max	0.10 max	0.0% max
Refractive index at 25°C (ASTM D1807)	1.6110 to 1.6120	1.6153 to 1.6173	1.6240 to 1.6260
Viscosity at 210°F (ASTM D445)	4.1 to 4.8	5.6 to 6.1	5.2 to 5.7
Flash point (Cleveland Open Cup)			
Fire Point (ASTM D92)	38 or lower	30 or lower	37 or lower
Specific gravity at 25°C/4°C (ASTM D1810)	1.505 to 1.510	1.518 to 1.528	1.741 to 1.742
Boiling point (ASTM D2154)	None to boiling	None to boiling	None to boiling
Distillation range (ASTM D2840 Modified)	1st drop 200 C min	1st drop 200 C min	10% 375 C min
Evaporation (ASTM D2840 Modified)	40% max to/over 270°C	35% max to/over 270 C	90% 400 max
	90% 373 to 391	90% 379 to 394	
Freezing point	56.4 ± 0.5%	55.6% min	43 ± 0.5%
Corrosion test	After heating with aluminum for 6 hrs at 200 to 220 C, the aluminum must not be corroded on either visual or weight inspection and the askarel should meet the following specification.		
Color, ASTM	150 max	200 max	200 max
Acidity (mg KOH/g)	0.014 max	0.014 max	0.01 max
Insoluble sediment (gm)	0.15 max	2.0 max	0.1 max
Condition	Clear	Clear	Clear
Stability (corrosion)	0.135 to 0.135% Dioxide	0.18 to 0.22% phenoxypropene oxide	0.13 to 0.22 % phenoxypropene oxide
Typical Properties			
Coefficient of Thermal Expansion	0.0007	0.0007	0.00068
Arc Inversion Time	Askarels of various compositional types are used. Under arcing conditions the gases produced are composed predominantly of non-combustible hydrogen chloride and may include varying amounts of combustible gases depending upon the askarel type. Oxidation systems incorporating these askarels will release or absorb gases when exposed to arc energy which are modified by diversity. As a precaution, switches should be removed from the askarel by bubbling dry nitrogen through the askarel until the dissolved gases are removed before any work is performed on the apparatus.		

*Similar to ASTM D2283 Specification Type G

†Similar to Underwriters Laboratories Inc. Standard No. 54/DIEA for Inerteen 70 and 30 and the Underwriters Laboratories Inc. Standard No. 54/DIEC*4 for Pyranol No. 10142

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a dry [illegible] only 125 [illegible] top [illegible] heavy insoluble in water only about 200 parts per billion [illegible] [illegible] in water at normal temperatures.

VII Precautions When Handling Drums, Tank Cars, and When Opening Transformers

The Institute of Electrical and Electronic Engineers Guide No. 70 (December, 1959) has been revised to give more detailed instructions and precautions. For description and illustrations of Transformer Explosions, see Appendix I. The guide is published by the Institute of Electrical & Electronics Engineers, Inc., 345 East 47th Street, New York, New York 10017.

The following are significant precautions:

A. Keep Dry During Handling

In filling, storing, moving drums and inspecting askarel — and in operating askarel transformers — take every precaution to guard the askarel insulation from exposure to high humidity and moisture contamination. Keep 5 or 55 gallon drums of askarel dry by storing drums on their sides with the bung at the highest point to keep water off the drum head (which can be sucked in to the askarel by the drum "breathing"). This precaution is not necessary when drums are stored indoors, which is the preferred place for storage.

To avoid leakage the drums used for askarel are of heavy construction. Stainless steel metal is used, with special rim seal and bung construction. The drums should be drained as completely as possible and then flushed twice with kerosene type solvent to remove all of the askarel. Accumulated liquids and washings should be collected and should be incinerated at high temperatures (e.g., about 2000°F to destroy the polychlorinated biphenyls (PCBs). See Section A, VIII).

Tank cars used to transport askarel are in exclusive service and not used interchangeably for other products. All cars must be unloaded through the top (dome fitting) either by pumping or with controlled pressure using dry air or dry nitrogen. If nitrogen has been used for unloading it is necessary to advise the shipper so that when the car returns the nitrogen can be replaced with dry air before any one may enter the car. If the car is to be unloaded by pumping it will be necessary to use a dryer on the air intake line to remove moisture.

All tank cars are fitted with steam coils which are available for unloading under extreme low temperature conditions.

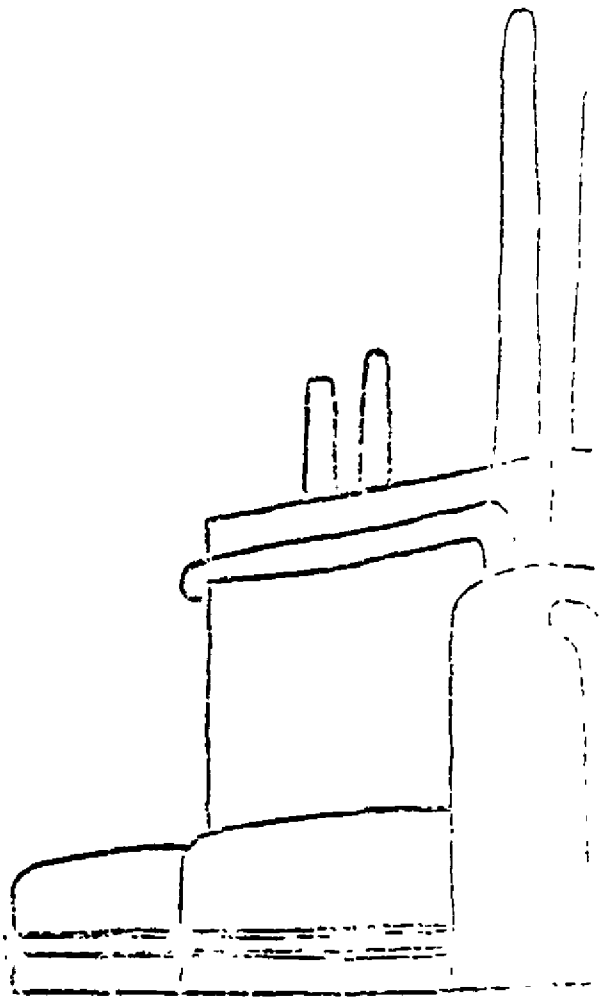
Container capacities and pumping temperatures and the related approximate viscosity ranges are given in Table III.

B. Use Only Approved Containers

Transformer askarel has been made, handled and used for over 30 years. It can be handled safely with recommended precautions. [illegible] spilling on hands, no serious skin irritation will occur. However, liquid askarel has a solvent action (similar to paint

Table III
Handling and Pumping Temperatures

Product	Unloading, Handling and Pumping Temperature °C	Approximate Viscosity Cps
[illegible]	20 [illegible]	100 [illegible]
[illegible]	20 [illegible]	100 [illegible]
[illegible]	20 [illegible]	100 [illegible]



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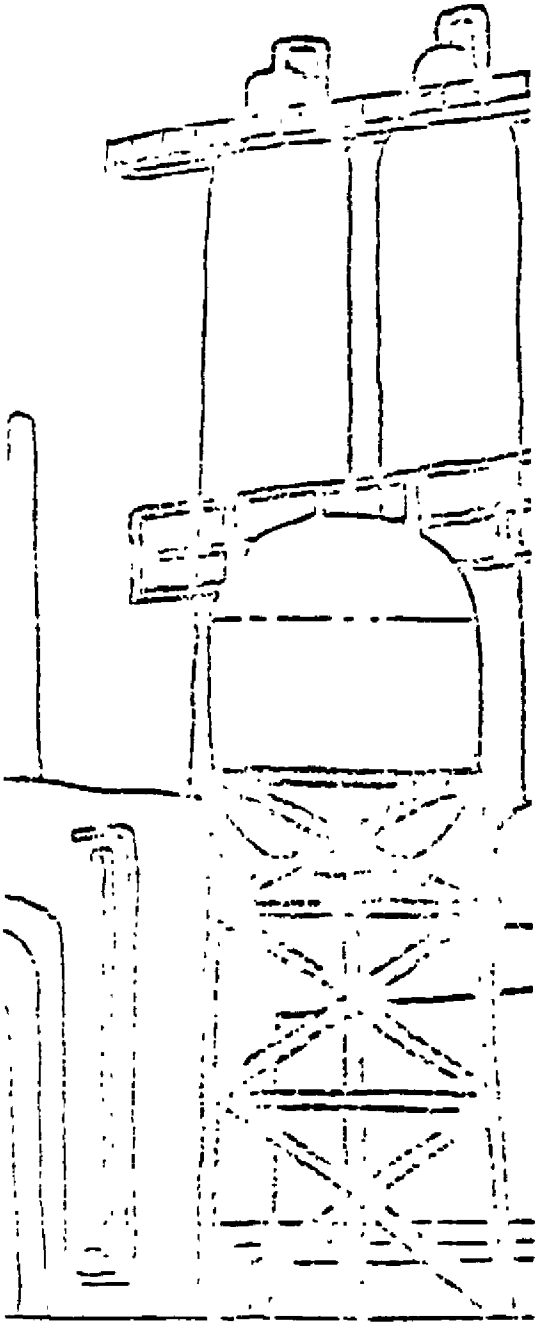

[illegible]

[illegible]

[illegible] and [illegible] ophthalmic cortisone acetate solution [illegible]

[illegible]

C. Precautions On Opening a Askarel Transformer

Askarels of various [illegible] types are used. Under [illegible] conditions the [illegible] produced while consisting of predominantly non combustible hydrogen chloride, can yield varying amounts of combustible gases depending upon the askarel type.

Insulation systems incorporating these askarels and cellulose or other organic materials may, when arced, produce [illegible] mixtures [illegible]. If mixture. As a precaution such gases should be removed from the askarel by bubbling dry nitrogen through the askarel and flushing the gas space with dry nitrogen before any work is performed on the apparatus.

VIII. Askarel Environmental Pollution

Transformer askarels contain polychlorinated biphenyls (PCBs) which have been used in the United States and elsewhere over the past 40 years for many industrial and consumer applications. During the past several years evidence has accumulated to indicate that PCBs are [illegible] dispersed throughout the environment and that they can have adverse ecological and toxicological effects.

The United States Government's Interdepartmental Task Force on PCBs, Com 72-10419, in their March 20, 1972 report titled *Polychlorinated Biphenyls and the Environment*, recommended restricting PCBs to use in capacitors and transformers.

This report is distributed by the National Technical Information Service, U.S. Department of Commerce, Springfield, [illegible] 22151.

A document titled "Guidelines for Handling and Disposal of [illegible] Transformer [illegible] Askarels Containing [illegible] has been [illegible] National Standards [illegible] Committee C107, 155 East 44th St., New York, New York 10017.

The [illegible] objectives and the composition of this committee are:

ANSI Committee C107

Scope:

[illegible]

Objectives:

1. Source [illegible] information and advice [illegible]
2. [illegible]
3. [illegible]

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O [illegible] ANSI [illegible] Institute of Electrical and Electronic Engineers, American Standards for Test [illegible] Electric Lighting and Power Association, Certified Equipment Verification Association, Environmental Protection Agency, Office of Environmental Health Services, Federal Services Administration, National Bureau of Standards, Department of the Army, Rural Electrification Administration, Division of Environmental Research, EPA, American Public Power Association, Water Pollution Control Federation, Flood and Dam Act, [illegible] National Fire Protection Association, U.S. Department of Labor, Occupational Safety and Health Administration, and various divisions of the U.S. Department of Interior.

The following are pertinent excerpts taken from the ANSI Guidelines for use for [illegible]:

1. LABELING askarel TRANSFORMERS
"All [illegible] and transformers should be labeled

Caution

The Insulating Liquid In This Transformer Contains Polychlorinated Biphenyls (PCBs). Care Should Be Taken To Prevent Entry Into The Environment In Case Of Malfunction Or Leaks. Consult The Instruction Manual Or The Manufacturer.

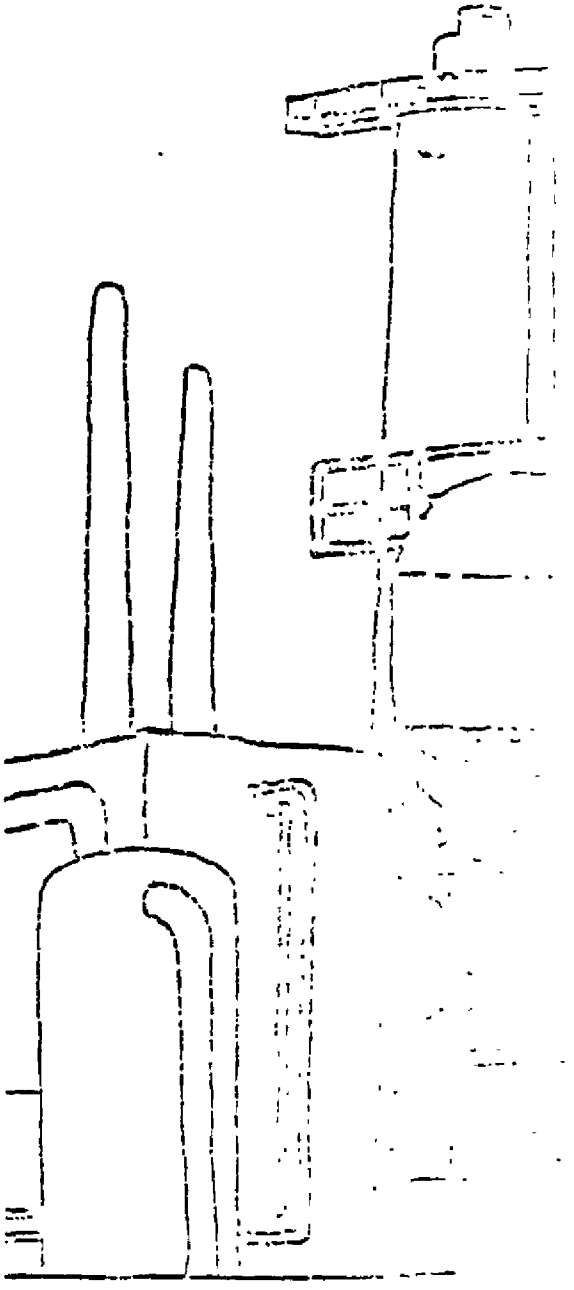
The transformer manufacturer should make similar warning labels available for use on previously installed transformers."

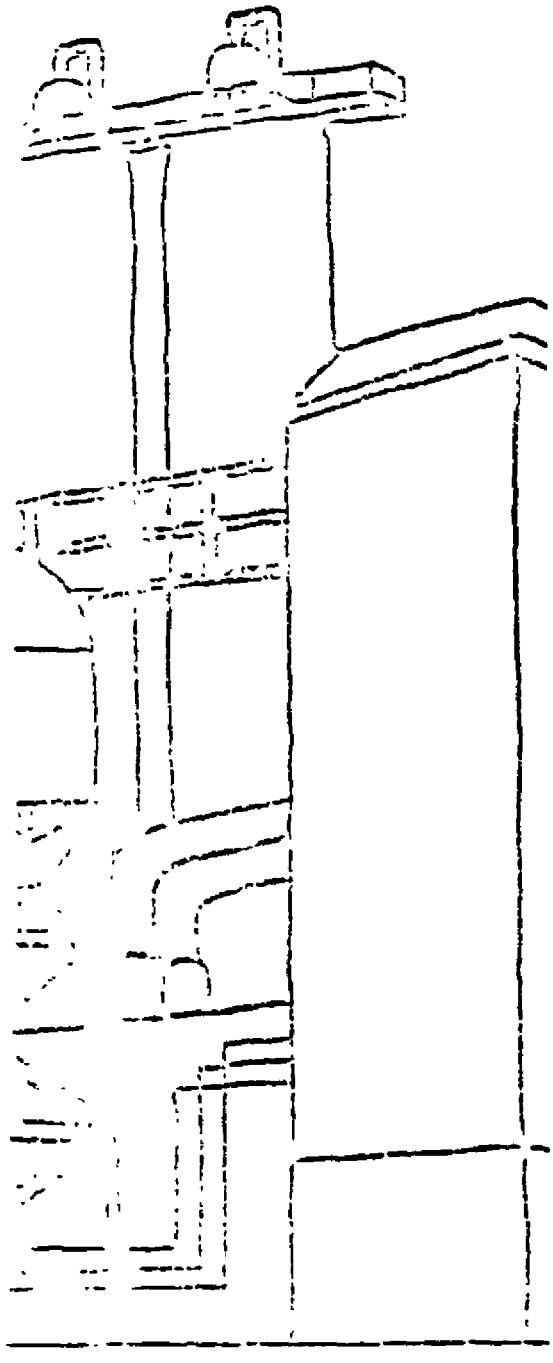
2. DISPOSAL OF LIQUID AND SOLID WASTES
"Disposal of askarel fluid and askarel-soaked materials must be [illegible] that [illegible] there is no significant release of [illegible] the environment. At present, disposal is accomplished by carefully controlled high temperature incineration of liquids and soaked solid wastes and by controlled dry landfill burial of apparatus and other hazardous [illegible] on a [illegible] has been previously drained and washed.

"Proper incineration indicates that proper incineration should include a [illegible] between dwell time and temperature in the incinerator plus oxygen availability and [illegible] to assure complete HCl formation (e.g., [illegible] seconds dwell time at temperature over 2100 F and 3% excess oxygen in stack gas (21 + 3%) seconds dwell time at 2700 F and 3% excess oxygen in stack gas)."

The MASE document [illegible] of facilities that can comply with [illegible] requirements. Monsanto has such an incinerator in [illegible] W. G. Krummrich Plant, Sauget, Illinois 62201, where [illegible] are made for [illegible] and disposal [illegible] current [illegible] 3 cents per pound. For a [illegible] of small [illegible] solid dry waste [illegible] is available by Federal Solid Waste Disposal Act.

3. CONSIDERATIONS FOR RELOCATING SKARELS
[illegible]





4. [illegible] SCRAP
   a. Drain all askarel [illegible] for [illegible] Scrap [illegible] to [illegible] the core and coils.
   b. Remove the core and coil assembly from the transformer and place it on the floor. Suitable absorbent material should be placed on the floor to absorb any askarel fluid that still drips from the transformer.
   c. [illegible]
   d. All [illegible] sawdust [illegible] regardless of quantity should be [illegible] appropriate [illegible] position.

5. TRANSFORMER DISPOSAL
   The [illegible] askarel filled transformer may be accomplished in either of two ways:
   a. Combine drainage and dismantling with the proper disposal of the askarel liquid and askarel-soaked components as described above.
   b. Disposition of askarel transformers by [illegible] scrap dealers should be avoided unless [illegible] first drained, followed by soaking of the [illegible] suitable solvent such as [illegible]. Accumulated liquids and washings are to be disposed of as described earlier.

IX. Expected Service Life

Manufacturers indicate that properly designed and installed askarel transformers are expected to give trouble-free service for at least 20 years. Since their introduction in 1932, the manufacturers report finding the overall failure rate to be less than 0.5% for all units under test and service conditions. The Edison Electric Institute's report (1956-1958) on their member utilities publishes the failure rate for askarel transformers as 0.13 per hundred banks per year.

Mr. Frank M. Clark, who invented transformer askarels at the G.E. Electric Company in the early 1920s, made the highly [illegible] comment based on his many years of experience with G.E. [illegible] (askarel-type) transformers that —

> *"The important thing is to keep them dry — others [illegible] alone."*

These words of [illegible] become [illegible] years when [illegible] rather [illegible] of [illegible] askarel [illegible]. The [illegible] understanding that the liquid is in a normally hermetically [illegible] system.

X. General Characteristics of Transformer Askarel Fluid

[illegible]

[illegible] the askarel

[illegible]

[illegible] moisture when [illegible]

XI. Sampling Transformer Askarel Fluid

The following precautions that sampling are quoted from the IEEE Guide:

"Representative samples, whether of the complete contents or only [illegible] extremely important from the standpoint of [illegible] Obviously, [illegible] sampling [illegible] in the sampling equipment [illegible] That is generally leads to [illegible] conclusions concerning quality and hours loss of time, effort and expense involved in [illegible] transporting, and testing the sample. It is strongly recommended that all of the procedures and precautions [illegible] in the latest revision of ASTM D 923 (Sampling Electrical Insulating Liquids) be followed.

Because of the high specific gravity (relative density) of askarel [illegible] some other impurities are most likely to be found [illegible] surface. The top sample, therefore, is considered to represent the [illegible]."

XII. Evaluation of Askarel Received in New Equipment

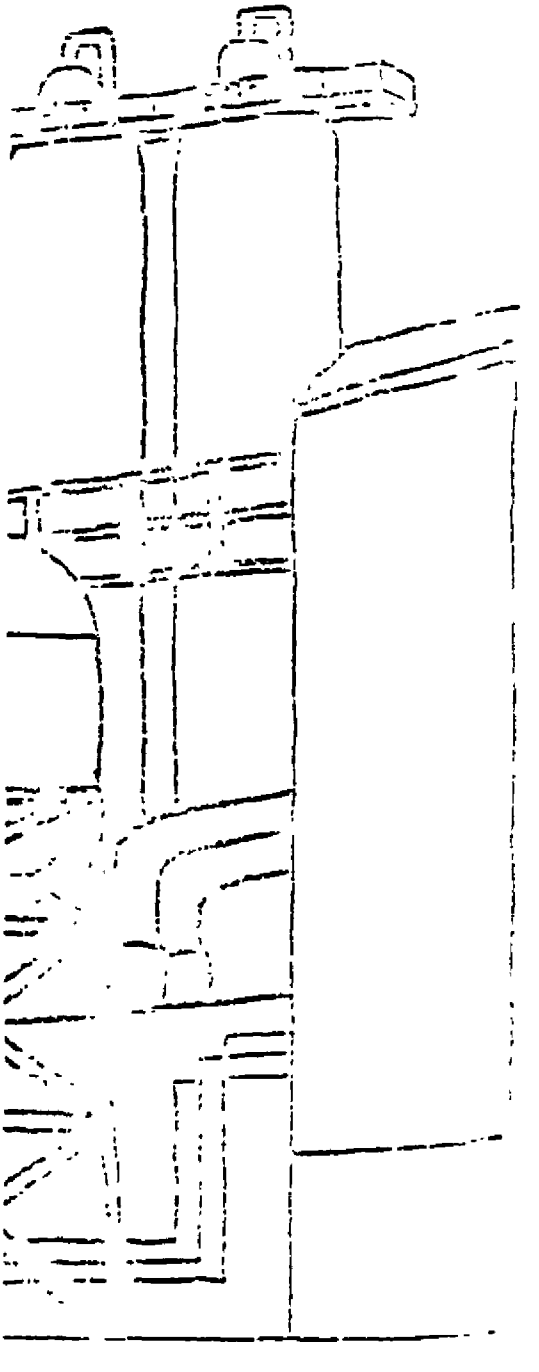
[illegible] to make has received [illegible] equipment [illegible] common to use the dielectric [illegible] and visual appearance as the most significant tests. [illegible] and trained personnel are available [illegible] may be obtained from the power factor, color [illegible] tests.

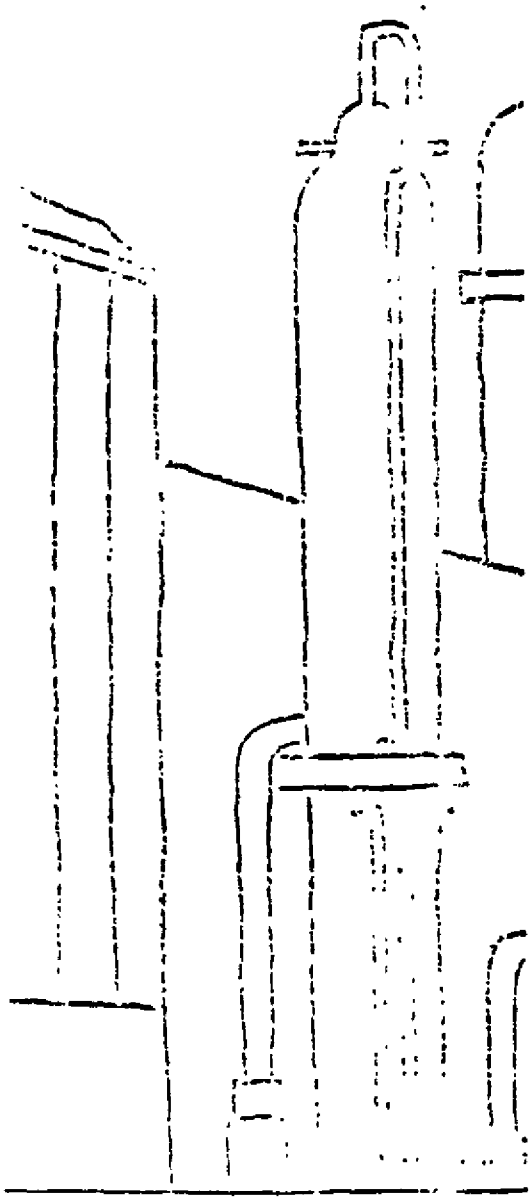
In sampling askarel contained in apparatus extreme care must be [illegible] to obtain a representative sample. ASTM [illegible] D 923 should be followed.

New equipment with askarel exhibiting the following characteristics is considered acceptable:

		ASTM Method
Dielectric Breakdown		
Voltage	30 kV min	D 877
Color	[illegible] max (Saybolt)	D [illegible]
Condition [illegible]	Clear	D [illegible]
[illegible]	[illegible] max	D [illegible]
[illegible] 75 C	[illegible]	D [illegible]

[illegible]





[illegible]

[illegible] investigated.

XIII. Dielectric Breakdown Voltage – Moisture Relationship

The dielectric breakdown voltage of a [illegible] moisture [illegible] dielectric breakdown voltage [illegible] in [illegible] and the askarel replaced.

If the dielectric breakdown voltage is checked periodically and [illegible] – this indicates moisture pick-up [illegible] down. When the dielectric breakdown voltage has dropped to [illegible] or less, an analysis for water is necessary. If water is found in excess of 40 ppm at room temperature, its source should be located and corrections made.

When the moisture content approaches 125 ppm (saturation level at room temperature), the dielectric breakdown voltage of askarel drops below the value required for efficient insulating. The moisture content should not be allowed to rise over 70 ppm [illegible] temperature. If the moisture content is found to be in a [illegible] range and the dielectric breakdown voltage is low, [illegible] manufacturer should be consulted.

Table IV shows the relationship of dielectric breakdown voltage [illegible] moisture and Table V indicates the approximate [illegible] in askarel and mineral oil.

Table IV
Relation of Dielectric Breakdown Voltage to Amount of Dissolved Water in Askarel and Mineral Oil

Water Content (PPM)	Breakdown Voltage Askarel	Breakdown Voltage Mineral Oil
0	70 KV	[illegible]
20	55	[illegible]
[illegible]	47	[illegible]
[illegible]	40	[illegible]
[illegible]	38	20
[illegible]	[illegible]	[illegible]

Table V

Approximate Solubility of Water in Transformer Askarel and Mineral Oil

°C	°F	Amount of water (ppm) dissolved in Askarel	Amount of water (ppm) dissolved in Mineral Oil
0	32	8	3
10	50	16	10
20	68	28	13
0	32	11	20
10	50	65	33
20	68	91	59
30	86	123	85
40	104	170	130

XIV. Turbidity

The presence of undissolved water in askarel may indicate dirt contamination and/or result from cold precipitation of the polychlorinated biphenyl compound that is used in the askarel Pyranol transformers. This range is normally at or below zero degrees F and 15 F below zero. To remove water by heating to 150 degrees C (302 F) is not practical.

High dielectric breakdown voltage will usually indicate that any turbidity present is not moisture and that the dielectric strength of the askarel is still excellent. However, if the dielectric strength is below 26 KV, moisture should be determined, using the Karl Fischer method (ASTM D 1533-60T).

The dielectric breakdown voltage test for askarel serves primarily as an indicator of moisture. It is by far the most important maintenance test for transformer askarel.

XV. Check Points for Maintaining Askarel Insulation

A. General Considerations

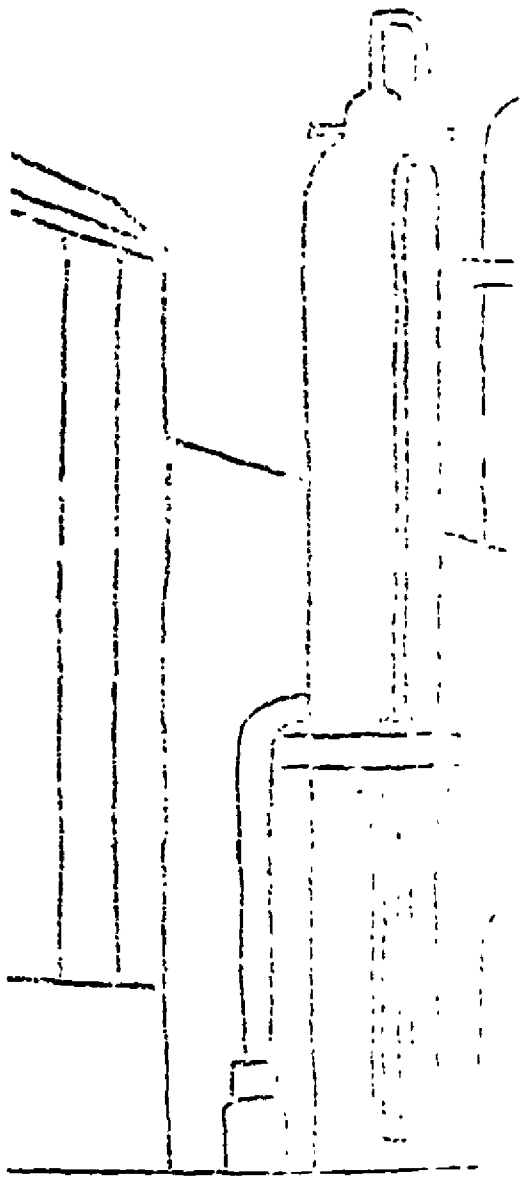
Modern askarel transformers with welded construction or silicone or Viton gaskets inside holes or, if flat and terminal compartment covers and with properly constructed bushings require little or no maintenance. With properly constructed transformers, annual or semi-annual visual inspection and dielectric breakdown voltage test of the askarel fluid should suffice for routine maintenance checking over many years of service.

However, many askarel units were installed in the early 1930's — before the development of some of the better insulating materials and before improved design criteria were established for sealing out moisture. Such early units should be and can be economically Leaky welded or flanged gaskets should be replaced. If the askarel has become contaminated, it should be replaced. At the same time, a general overhaul of the unit and gaskets should be made.

Oil preservation equipment is also available for general repairs. Leaky gaskets can be repaired temporarily by painting over the joint with epoxy cement.

A survey of users indicates a good number of units have been in service for 30 years with no leaks or continuous service problems. Units can be checked by the following steps: Inspect for mud, moisture.

The oil tank should be equipped with a gauge for measuring pressure above and below atmospheric pressure.



[illegible]

[illegible] with [illegible] leaks are sealed by [illegible] body [illegible]

B [illegible] Sealing Procedures

The [illegible] should [illegible] the following [illegible] for sealing

1. Welding Construction: Covers [illegible] and terminal [illegible] connections [illegible] should be welded.
2. Bushing Connections: A number of bushings have been developed to obtain a proper seal for [illegible] connection through the tank wall. They [illegible] follows:
   1) Welded Type (Bushing [illegible] welded [illegible])
      a. Cast resin bushing [illegible] to the bushing stud and [illegible] stainless [illegible] copper flanges.
      b. Rolled flange bushing with the metal [illegible] seal at the cap and [illegible] made by [illegible] into grooves in the porcelain over silicone rubber rings. The seal between the cap and stud is made by welding.
      c. Porcelain or glass bushings with metal to glass or metal to porcelain seals.
   2) Bolted Type (Bolted to tank wall)
      a. Cast resin bushings with either cast or metal flanges containing recessed gasket grooves.
      b. Porcelain or glass bushings with flanges containing recessed grooves or gasket stop.

The gaskets may be either of rectangular or circular cross section, usually ¼ inch thick. Bushings with recessed grooves are suitable to use with cork, cork nitrile rubber combinations or nitrile rubber as well as gasket materials such as silicone or Viton.

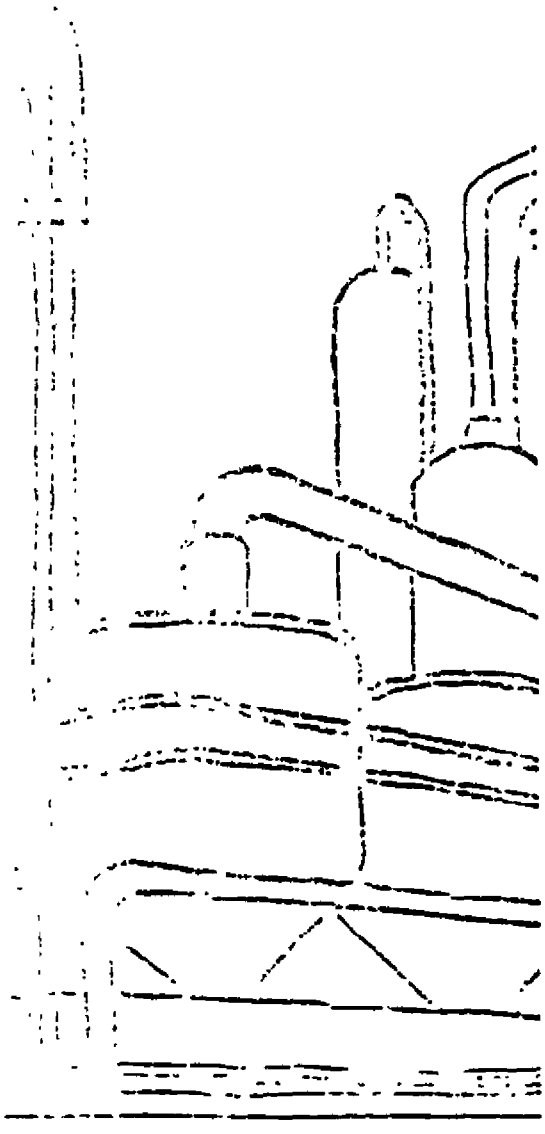
3. Small Size Connections: When not possible [illegible] size connection seals should be made [illegible] stainless steel rings. The surfaces must be [illegible] parallel. The [illegible] between the steel [illegible] of the [illegible] tallic rings should be either silicone or Viton.
4. Gaskets for Hand Hole Covers: Modern [illegible] gaskets. Such gaskets must be [illegible]. The groove [illegible] is machined into the [illegible]. However [illegible] form [illegible] strips to the [illegible] the cover. [illegible] of the groove or stud. A rectangular cross [illegible] used.

The [illegible] Dow Corning [illegible] [illegible]

[illegible]

[illegible]

[illegible]



[illegible]

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[illegible] barrier

NOTE: [illegible] 50 [illegible] manufacturers [illegible] Procurements

C. [illegible]

[illegible]

1. [illegible] Corks for the main tank, [illegible] held in [illegible] by [illegible] Electric Company's Crystal [illegible] is used to cement the cork to the [illegible]

The following is recommended for sealing with the cork — [illegible]

Use Armstrong [illegible] cork nitrile material or equivalent. [illegible] material. A convenient [illegible] is to [illegible] Keystone Type [illegible] Style No. 323 [illegible] (about [illegible])

The joints — and also the gasket — should be cemented to the flange, using one of the above cements. Excess cement should not be allowed to reach the interior of the transformer.

After installation and potting, the outside edge of the gasket should be coated thoroughly with epoxy cement to increase [illegible] resistance.

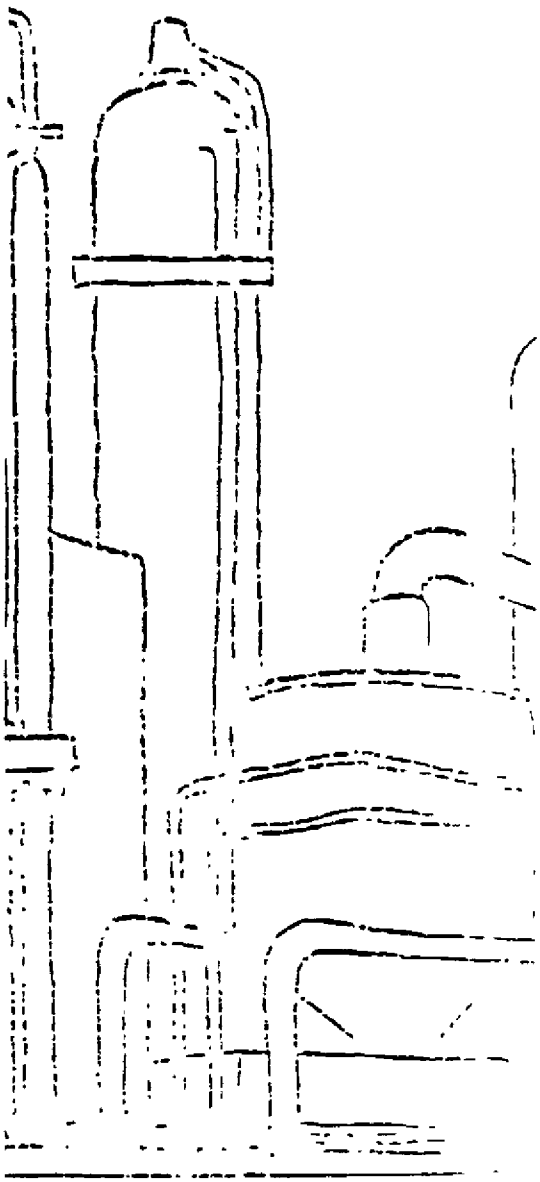
This epoxy cement is a paste to which a curing catalyst is added immediately before use. Typical are:

a. Epoxy Patch Kit #1C
Hysol Corporation, Olean, New York
b. [illegible] Resin #[illegible]
[illegible] Manufacturing Company
St. Paul, Minnesota
c. [illegible] and Activator Type S
Armstrong Products Company
Argonne Road, [illegible], Indiana
d. Adhesive [illegible], Synthetics Oil Co. Company, Cleveland, Ohio, [illegible] with activator [illegible] (Carbide and Carbon Chemical Company)

2. [illegible]

[illegible]

[illegible] Fluid Insertion and [illegible] Checkpoints [illegible]



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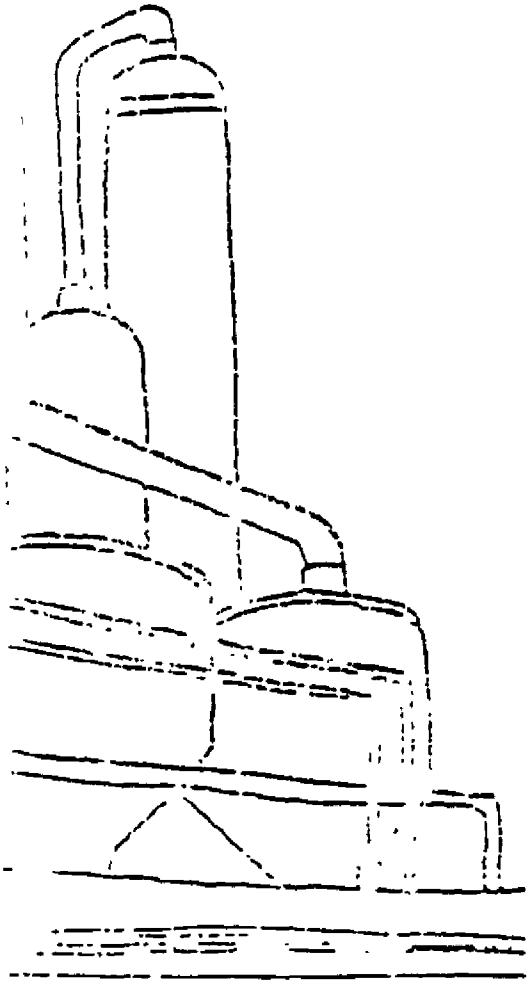

A [illegible]

[illegible]

[illegible]

8 Dielectric breakdown voltage

If the dielectric breakdown voltage has decreased [illegible] from [illegible] KV [illegible] 25 [illegible] A CHECK FOR [illegible] ASTM D1533 (Karl Fischer Method)

The dielectric breakdown voltage [illegible] to [illegible] visual [illegible] test [illegible] transformers have service records of 25 to 30 years on [illegible] askarel

XVII Inspection Checklist

1 If askarel is clear [illegible] though darkened [illegible] has no sediment or turbidity [illegible] dielectric breakdown voltage over 25 KV — given the inspection "OK"

2 If askarel is clear but has foreign color of blue green red [illegible] is "extracting color" from internal materials. This is not of [illegible] operating hazard when [illegible] dielectric breakdown voltage [illegible] 28 KV and moisture remains low. However, this [illegible] calls for checking [illegible] condition of [illegible] and consulting the transformer maker. [illegible] the fluid care should be taken to avoid [illegible] into the askarel from paint that may be inside or outside of the [illegible] valve

3 If the moisture content is found to be above 70 ppm [illegible] temperature then sampling should be [illegible] intervals to establish a possible trend, particularly on [illegible] installations

4 If askarel is clear but [illegible] breakdown voltage drops to 25 or lower [illegible] and moisture rises over 30 [illegible] operation [illegible] "refining". If the [illegible] [illegible] for water [illegible] [illegible] transformer [illegible]

5 [illegible]

[illegible]

[illegible]

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VIII Contamination in Transformers

[illegible] particulate [illegible] decomposition products are [illegible] to be [illegible] contaminating [illegible] in [illegible] askarel.

[illegible] normally used for the [illegible] of contamination [illegible] transformers [illegible] in [illegible] transformers due to the extreme [illegible] of extraneous [illegible] materials. This [illegible] power factor as illustrated in [illegible] VI [illegible] breakdown voltage.

Table VI
Effect of Common Insulation Materials on Power Factor and Dielectric Strength
(Heat Aged 96 Hours in Askarel at 100°C)

Material Immersed	Askarel After Exposure: Power Factor Percent at 60 cyc. 100°C	Askarel After Exposure: Dielectric Strength 25°C
[illegible] (Nitrol)	1.0	35 KV
[illegible] varnished cloth	55.0	42
[illegible]	1.5	40
Pressboard	2.0	37
Manila paper	1.5	39
Phenol formaldehyde resins	1.6	41
Shellac	6.0	36
Iron	5.0	39
Synthetic rubber	70.0	39

Similarly, trace contaminants from commonly used construction materials can lower the volume-resistivity of askarel without affecting its dielectric breakdown voltage. This is shown in Table VII.

Table VII
Effect of Common Insulation Materials on Volume Resistivity of Askarel

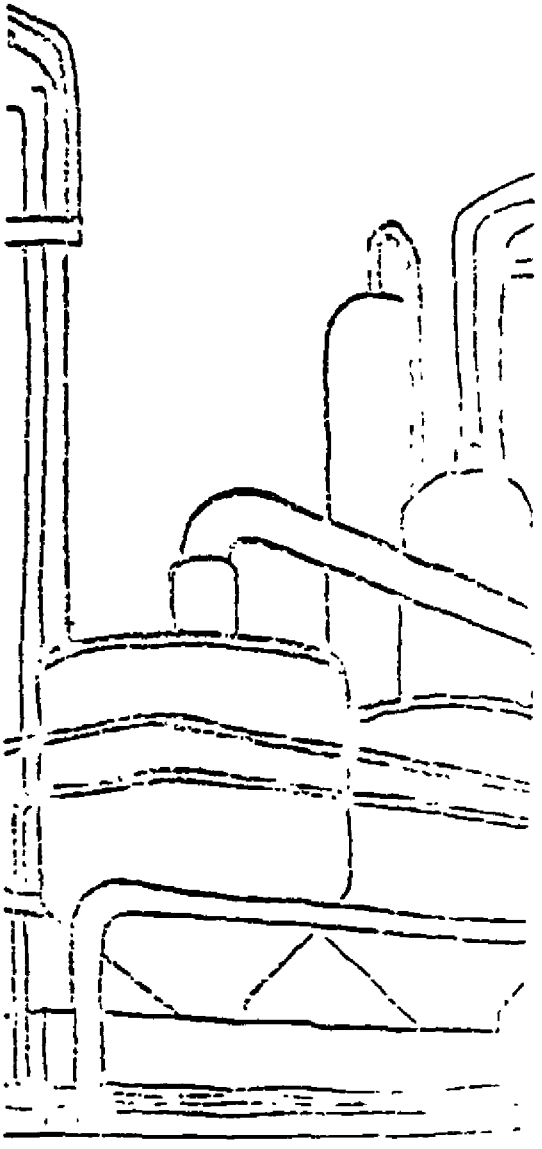
Sample	Volume Resistivity x 10⁹ ohm-cm (at 100°C, 500 Volts DC, 0.1 [illegible])
1. New askarel before heat aging	2,000
2. [illegible] askarel after heat aging 96 hours at 100°C	1,900
3. After heat aging with 1 sq. inch specimens of:	
a. Phenolic resin tap changer material	1,200
b. [illegible]	750
c. Grade A pressboard (tan)	500
d. Grade A pressboard (gray)	500
e. Grade A pressboard, laminated strip	400
f. Cotton wrapping	[illegible]
g. Glyptal 1278 [illegible] cured 48 hrs. at 110°C	100

[illegible] trace contamination easily lowers volume resistivity from high [illegible] contamination [illegible] when [illegible] does not lower the resistivity below the order of 10⁹ ohm-cm at 100°C.

The different behavior of askarel vs. mineral oil in these respects can be [illegible]

High power factor and low volume resistivity in transformer [illegible] commonly [illegible] as [illegible] of this [illegible] and broken down chemically or [illegible] moisture is present.

[illegible] NOT [illegible] askarel [illegible] volt [illegible] content.



MONS 219772



XIX. ASTM Method For Investigating The Compatibility of Transformer Insulation and Construction Materials in Askarels

This method uses the change of electrical properties of transformer insulation and construction materials when exposed to askarel and contrasts them with unexposed materials. Immediate major "contaminating" effect on the askarel fluid. Detailed long-time contamination effects may not be detected.

The method also utilizes various physical tests on the insulation and construction materials after controlled exposure to askarel to determine the compatibility of these materials with transformer askarel.

Properly proportioned specimens of the insulation or structural materials are immersed in retested askarel for 168 hours (100 ± 1°C) in a forced draft oven. Changes in electrical and chemical properties of the transformer askarel are compared against a control sample of the askarel treated in the same manner in absence of the test specimens.

Dissipation factor (ASTM D 924) change is one of the criteria used. The askarel fluid is refined by absorptive treatment to a dissipation factor level of 0.05 max. at 100°C and 60 Hz or 0.001 max. at 25°C and 60 Hz. Corresponding values of the askarel fluid after heating 168 hours at 100°C in absence of a test specimen are 0.075 and 0.02 respectively. The maximum dissipation factor levels suggested for the askarel after heating in presence of the test specimen are 0.20 at 100°C and 60 Hz and 0.04 at 25°C and 60 Hz.

XX. Defining Askarel for Reuse

A. Filtering Through Dry Blotter Paper to Remove Moisture and Extraneous Particles:

Most operators prefer portable refining apparatus consisting of a plate press fitted with a dolly, available from Sta-Rite Industries, Illinois or General Electric Company. Portable filter units for the cartridge filter type available from Industrial Filter Corporation, Lebanon, Indiana. Filter paper sheets for the plate press are available from Carl Schleicher and Schuell Company, Keene, New Hampshire and manufacturers of filter presses listed above.

The filter paper must be dried immediately before use. For best results, spread the paper for maximum surface exposure in a hot air circulating oven and heat for 4 to 6 hours at 110°C.

Circulate the askarel hot (but not over 40°C) through the filter fitted with the dry paper liners.

After filtering, the dielectric breakdown voltage of the askarel should be 25 kV minimum.

1. Precautions: Filtering should not be done with the askarel hot (above 25°C).
2. Any transformer units and spares on hand should be tested with unexposed materials. (Be sure all oil is removed from units before testing with Stoddard, Magnesol, Fullers Earth or like gels. Hydrated gels are unsuitable.)

[illegible]

[illegible]