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IPHENYL'S

Capacitor Products Dept.
September, 1975

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GENP 005275

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WHAT ARE PCB'S?

Family of synthetic, non-flammable insulating fluids
 Diphenyl + Chlorine $\xrightarrow{\text{[cat.]}}$ PCB (210 isomers and homologs)

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Insulating Characteristics

High dielectric constant
 Low dielectric loss
 Stable under electrical stress
 Resistant to high temperatures
 Non-gassing, corona extinguishing
 Hydrolysis resistant

Chemical and Physical Characteristics of 1016

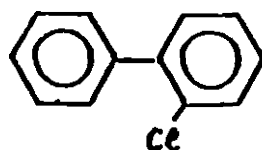
Odorless, colorless oil
 High boiling point ($> 300^{\circ}\text{C}$).
 Heavier than water (density 1.36 gm/cc)
 Low water solubility (~ 200 ppb)
 Relatively inert and unreactive
 Non-flammable

PRINCIPAL PCB HOMOLOGS IN

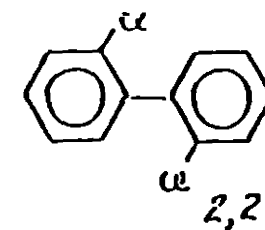
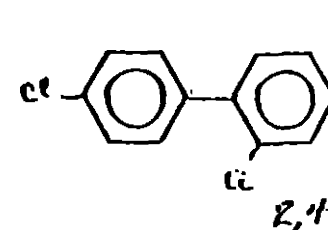
MCS-1016 AROCHLOR

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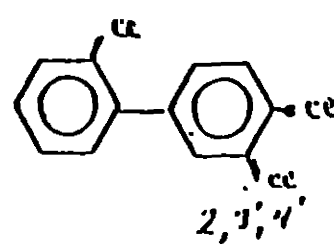
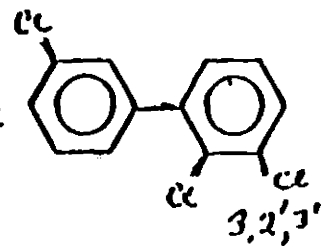
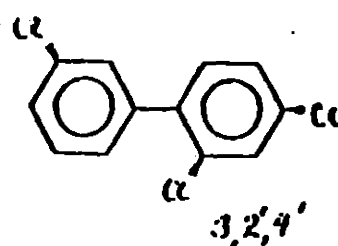
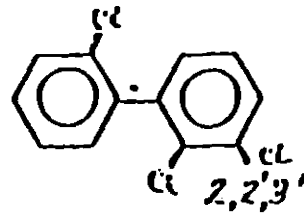
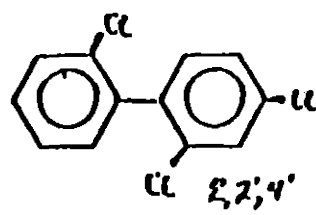
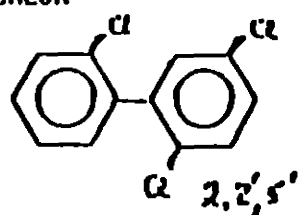
MONOCHLOR



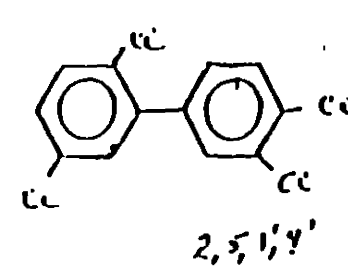
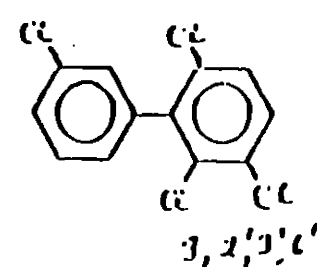
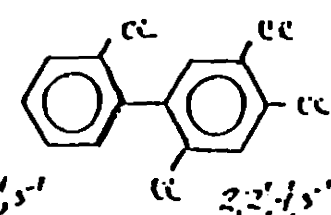
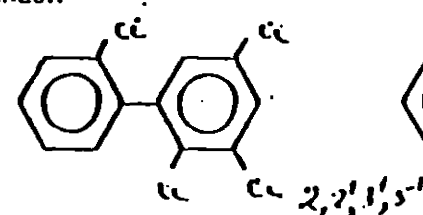
DICHLOR



TRICHLOR



TETRACHLOR



HISTORY AND USE

Discovery & Development of Applications

1. Developed in the late 1920's by Federal Phosphorus Co. and Swann Research Co. (later purchased by Monsanto in the early 1930's).
2. Material first presented to General Electric Co. for possible electrical applications soon after discovery in late 1920's.
3. First introduced in impregnated capacitors in 1931 by General Electric Co. as a replacement for mineral oil.
4. Conversion by major manufacturers of impregnated capacitors from 1931 to 1936. By 1936 $\approx 90\%$ of impregnated capacitors utilized Monsanto type 1254 PCB.
5. Introduction to liquid filled transformers of type 1260 PCB by General Electric Co. in the early 1930's.
6. Other applications developed by Monsanto during the 1930's included:
 - Heat Exchanger Fluid
 - Use as Hydraulic Fluid
 - Carbonless Reproducing Paper
 - Paints and Specialty Inks
7. Phase out by Monsanto of all other PCB applications except dielectrics (capacitors and transformers). In 1970 other applications amounted to approximately 45% and by 1972 they were reduced to almost zero.

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Use in the Capacitor Department

1. First power capacitors impregnated with 1254 PCB manufactured at Pittsfield, Mass. in 1931. Principal capacitor impregnant by 1936.
2. Introduction of low temperature 1436 PCB in early 1940's.
3. Capacitor Department moved from Pittsfield, Mass. to Hudson Falls, N. Y. (Power 1951, Small Industrial 1946).
4. Change from 1254 to 1242 PCB's for economic considerations during early 1950's.
5. Change from 1200 series to 1016 PCB's for environmental considerations (greater biodegradability) in October 1971.

PCB's vs. ALTERNATIVE FLUIDS

	<u>PCB</u>	<u>Mineral oil</u>	<u>Econo1</u>	<u>Monsanto 1230</u>
Liquid Cost	3	1	2	4
Refining Ease	1	1	2	3
Impregnation Cost	1	2	3	2(?)
Product Reliability	1	2	3	2(?)
Capacitor Cost	1	4	2	3
Capacitor Size	1	4	2	2
Corona Resistance	1	4	3	2
Flammability	1	4	4	4
Environmental Suitability	4	1	2	2(?)

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(Numbers indicate relative rank from best to worst.)

ENVIRONMENTAL CONSIDERATIONS

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- Background** - Persistent in the environment as a result of stability and low water solubility
- Widely dispersed in the environment due to past usage history
 - Accumulates in fatty tissue because of high oil solubility

Toxicity Hazard

- Aquatic Life** - Concentration factors and LC50's measured for many species, usually with Arochlor 1242 and 1254, not 1016.
- Mammals** - Feeding studies conducted with various species, usually at high levels in the diet and with high chlorine content Arochlor. Observed have been liver changes, low weight gains, skin reddening, loss of hair. Additional work in progress
- Man** - Based upon the Japanese "Yusho" incident, the FDA established tentative tolerances for various foods. Chloracne has been observed in some workers,

ACTIONSPrior to August, 1975

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1. Manifold System for Filling Large Power Capacitors

During the late 1960's and early 1970's a manifold system was implemented to impregnate large power capacitors by use of a sealed connection. This has eliminated the PCB discharges associated with the previous flood fill process.

2. Change from type 1242 to 1016 PCB Liquid

In October 1971 the Capacitor Department changed from the higher chlorinated 1242 PCB to the less chlorinated type 1016. The 1016 type has similar chemical characteristics with the advantages of greater biodegradability and reduced toxicity.

3. Elimination of PCB Discharges from Wash Machines

Two wash machines are utilized to clean the PCB's from Small Industrial capacitors following the flood fill impregnation process. Three years ago machines were implemented to drain excess PCB's from the cover depressions prior to sealing and washing. Until two years ago rinse water from these machines was discharged to the drain system. It is now recycled, as is the wash water, and incinerated when saturated with PCB's.

4. Detailed Analysis & Recommendation Report

In June 1975 a detailed study was published by Clark Dietz and Assoc. This study, funded by the Capacitor Dept., is a thorough survey of the wastewater systems of the Hudson Falls and Fort Edward plants including extensive measurements of PCB discharges. Included in this report are detailed recommendations to reduce total PCB discharges from both plants to below 80 grams per day.

5. Segregation of Process Water from Storm Water

During the past year an extensive program has been implemented to separate process water from other discharges to facilitate removal of PCB's. This included the re-piping of storm drains and adding dams to floor trenches in areas where PCB's are used.

6. Development of ECONOL

As an alternate to PCB's as a capacitor impregnant the Capacitor Department developed and implemented the use of a non-toxic ester. Facilities are now in place to produce approximately 1 million ECONOL capacitors per year.

7. Spill Prevention

At the Hudson Falls Plant a curbing has been placed around the PCB storage tanks. This prevents surface water drainage from this area and provides a means of containing potential spills.

Actions to be Completed by Year End 1975

1. Monitoring Stations on Wastewater Discharge

Automatic monitoring stations are being installed on the wastewater discharges of both the Hudson Falls and Fort Edward Plant. These stations will provide an around the clock composite sample for PCB analysis.

2. Containment of PCB Discharges from Water Seal Vacuum Pumps

The (2) automatic treat machines at the Fort Edward Plant utilizes water seal vacuum pumps that presently discharge a large volume of water to the drain. Equipment is now being procured to provide a recirculating water system for these pumps.

3. Control of Discharges from Wash and Laboratory Sinks

By the containment of discharges and controlled use of sinks PCB discharges from the washing of hands are being eliminated.

4. Containment of Solid Waste Contaminated with PCB's

Presently all scrap capacitors, filter media, and other PCB contaminated solids are being collected in resealable 55 gallon steel drums at both plants. This will be continued for a period of time to analyze costs and disposition requirements for filled drums.