Monsanto

COMPANY CONFIDENTIAL

FROM (NAME & LOCATION): E. E. Stewart - W. G. Krummrich Plant

DATE: February 21, 1974

SUBJECT: PROPOSED POLYCHLORINATED BIPHENYL STANDARD

REFERENCE:

TO : P. E. Heisler

cc: G. L. Bratsch
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P. B. Hodges - G.O.
W. B. Papageorge - G.O.

Attached are the copies of the report covering the progress at W. G. Krummrich Plant in reducing PCB in the effluent in recent years. Also included are a status report of activities presently being carried out and the plan to further reduce PCB's in the future.

Please forward copies to Paul Hodges and appropriate people at General Offices for their preparation of the presentation for the Federal EPA.

E. E. Stewart

/ghw

MONS 042701

IN - 10 REV. 1 72

I. PCB Loss Control Data

The following loss control data graphs reflect the trends in the PCB content in various major monitored streams within the W. G. Krummrich Plant and at the Sauget Waste Treatment Plant.

Figure I - Depicts measured PCB losses at

A. Total Plant Losses were measured at the 24" and 30" sewers from the W. G. Krummrich Plant. 99% of the total WGK effluent flows from the plant at these two sewers.

Routine monitoring was discontinued in early 1971 when it became evident that more reliable and meaningful data could be obtained at other monitoring locations.

B. Manufacturing departments loss data represent continuous stream analysis data from the Aroclor manufacturing department (Dept. 246) and from the Incinerator area (Dept. 831).

Information prior to June 1972 is not included because prior data related to a different monitoring system.

Figure II - Depicts measured PCB losses in the influent and effluent at the Sauget Waste Treatment Plant.

Data points prior to July 1970 may represent from one to several samples taken during the respective month. All data after July 1970 are average monthly values taken from semi-continuous samplers.

The following Table I reflects average yearly data from the various monitoring locations.

Table I

Monitoring Location	1969	1970	1971	1972	1973
	(All data in lbs/day)				
Manufacturing Departments	No data	--	--	2	1-1/2
WGK Plant	No data	--	6	--	--
Sauget WTP Influent	1100-600	217	43	19	10
Sauget WTP Effluent	300	78	19	7	5

FIGURE I

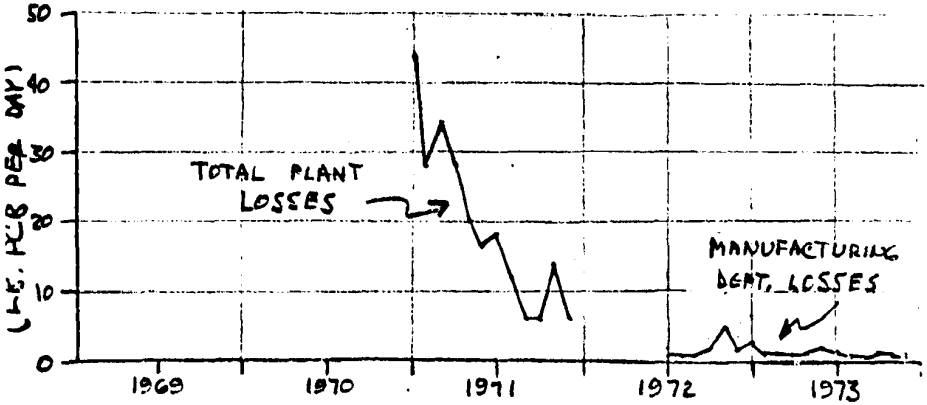
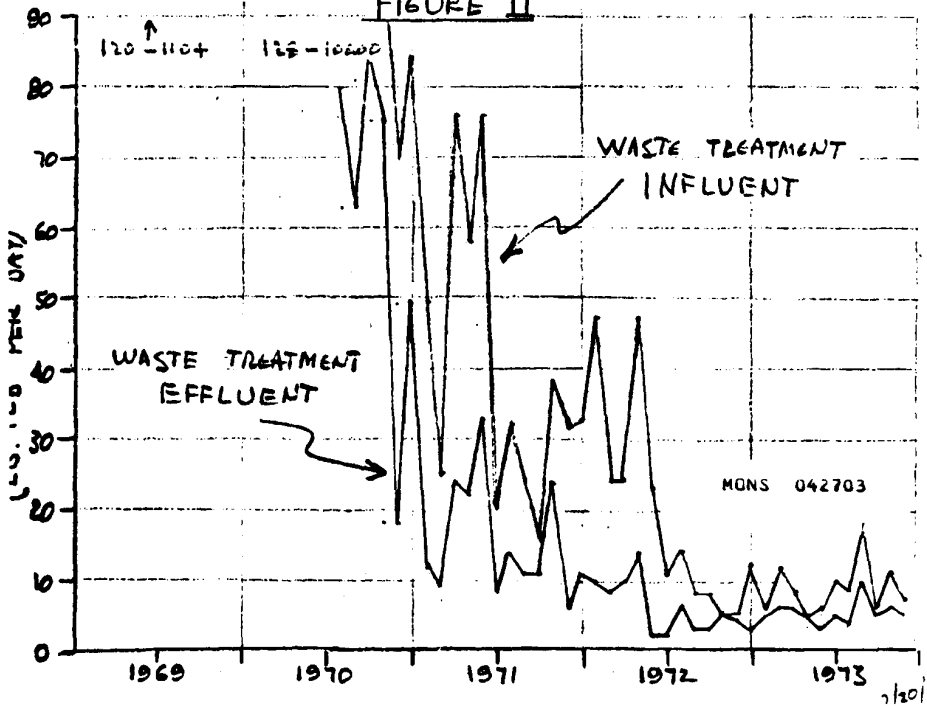


FIGURE II



II. WGK - Monsanto Village Sewer System

The following sketch is a very simplified drawing of the sewer system where PCB contamination is possible at present. Also noted on the sketch are points where previous contamination could have occurred prior to advent of the current containment - control program.

A. On the attached graph PCB's are present as PCB's and can enter effluent streams from the following areas. Loss flows are represented by a solid line.
   1. Department 246
   2. Incinerator
   3. Repair Track
   4. #11 Substation
   5. #17 Substation
   6. Laboratory

B. The failure of control devices could result in possible PCB contamination from the Dept. 246 off-gas at Depts. 236 or Dept. 217. Possible loss flows are represented by a dotted line.

C. Past actual loss points within the plant boundary are spotted by arrows on the sketch. These points represent some dozen sites where PCB's were at one time used as either a heat transfer media or a hydraulic fluid. Other miscellaneous previous contamination point sources are also identified.

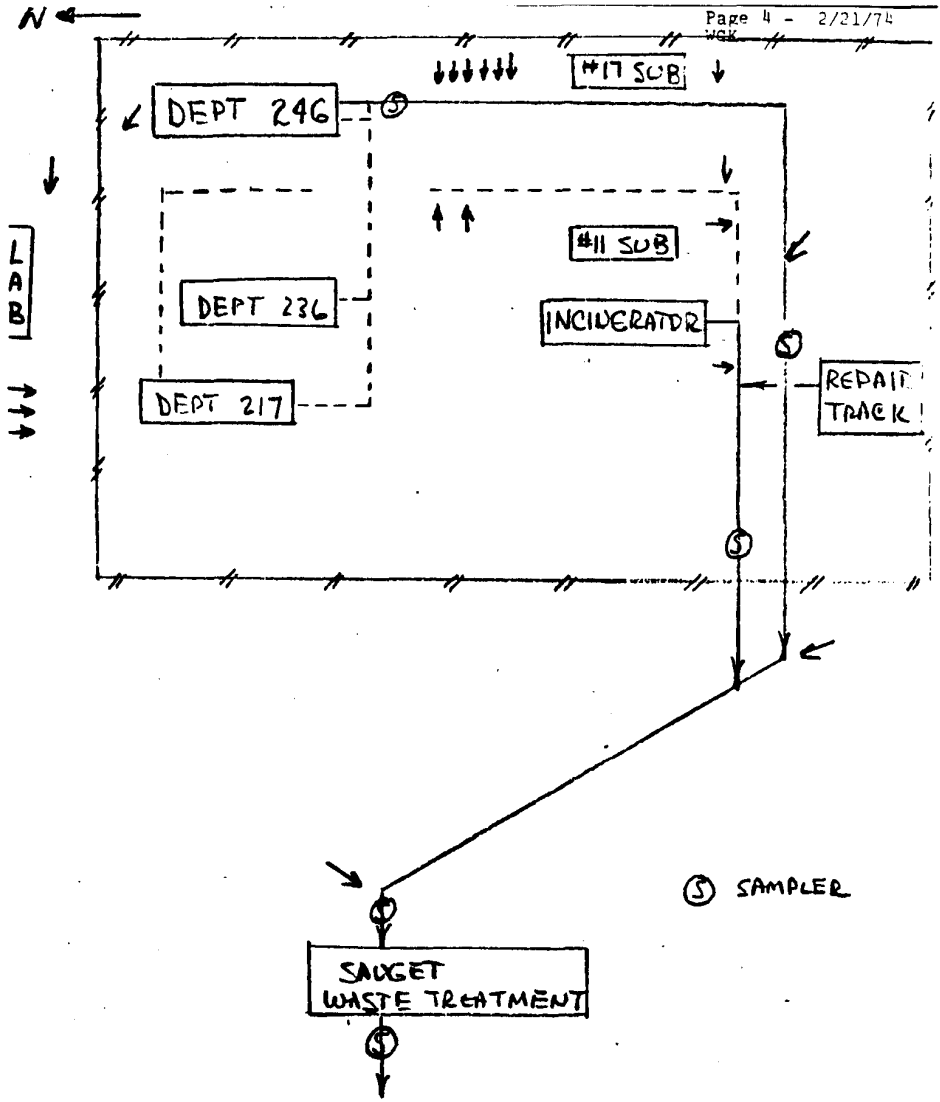
   Although PCB's have been removed by either substitution or by elimination of the practice at the various points, previous losses prior to the current containment-control program will have and may be contributing to our present "background" pick-up.

D. Past actual point sources from outside the plant boundary are also spotted by arrows on the sketch. These represent flows from surrounding industries and the Village of Sauget. It is estimated the drainage area covers about 1000 acres outside the WGK boundary. (about 90 acres within plant)

Attached reference drawings are engineering drawings of the total sewer system.

Sheet D-465-G11 "WGK 1961 Block Plan & Monsanto Village Sewers".

TS-D-10580 "Plant Sewer Map"



MONS 042705

SKETCH

2/20/7

III. Manufacture of More Biodegradable PCB's

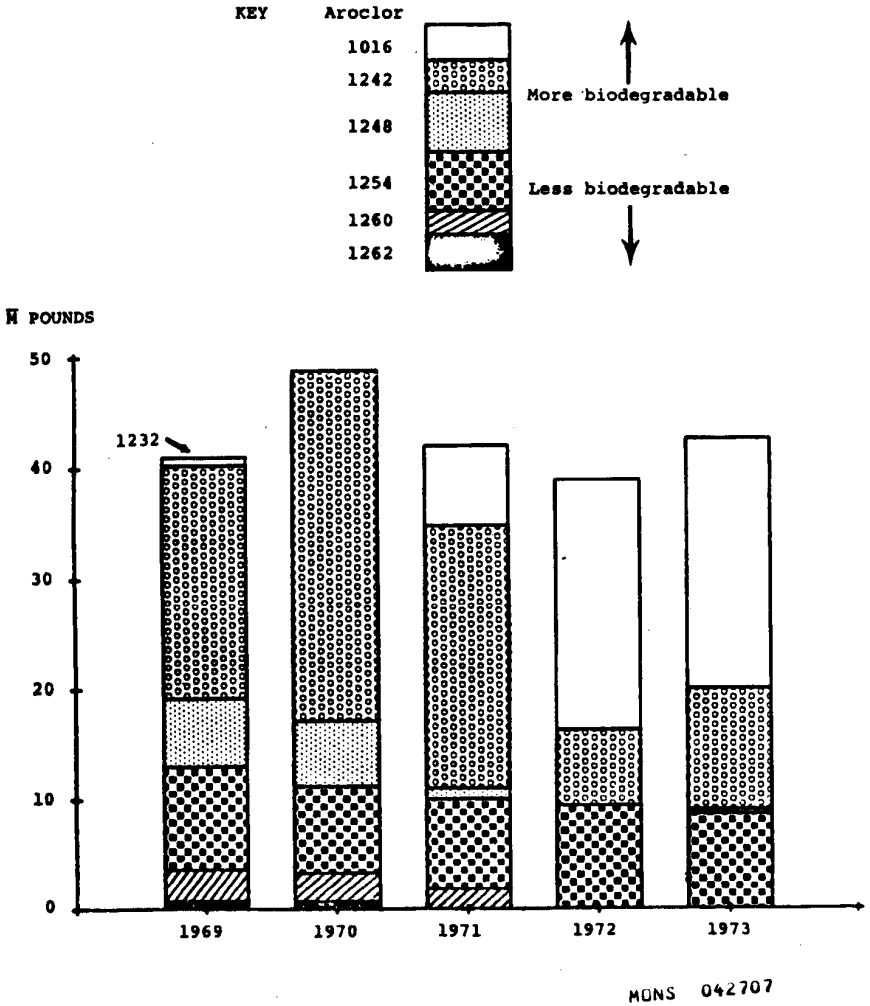
In 1971, we installed a new distillation column in our manufacturing department at a cost of $970,000. This allows us to separate the higher chlorinated, less biodegradable compounds from the lower chlorinated, more biodegradable ones.

Our PCB's are known by the trade name Aroclor. We manufacture different grades of Aroclor (1016, 1242, 1254, for example). The lower the grade number, the less chlorinated and more biodegradable is the product.

The current production of the lower grade Aroclor (1016) totaled more than 50% of our PCB production in 1973. Production of the higher chlorinated products (Aroclor 1248 and above) has decreased more than 50% since 1969.

The chart on the next page illustrates how our production mix has changed during the past five years.

AROCLOR PRODUCTION AT THE Wm. G. KRUMMRICH PLANT



MONS 042707

IV. Contain - Control - Monitor PCB's

Efforts to contain, control and monitor PCB's started in 1969 and continue at present via a dynamic action control program.

Numerous programs were established and implemented, projects were completed, extensive educational/housekeeping programs were developed and initiated and sophisticated analytical sampling techniques were developed to CONTAIN - CONTROL and MONITOR PCB's within the W. G. Krummrich Plant.

A chronological listing of activities can best depict plant efforts in this area.

1969

CONTAIN: First action taken to contain PCB's within the department was to install weirs in the departmental trench sewers to retain liquid PCB's within the manufacturing department.

CONTROL: Plant edict established to discontinue sewering used PCB's within the plant. Aimed primarily at Therminol change-outs in heat transfer units within plant.

MONITOR: An electron capture gas chromatographic method was developed by Research to detect PCB's in departmental and plant effluent streams. All analyses done at Research facilities outside plant.

1970

CONTAIN: 2000 gallon settling basin installed in manufacturing department to collect and contain PCB's in the event of an accidental spill or equipment failure. Also serves as collection point from major departmental sewer trenches. The heavier and virtually insoluble PCB's will settle to the bottom of the basin.

CONTROL: Demister and catch tank installed in aeration step in process prior to discharging to sewer.

Miscellaneous piping alteration made to effect reduced losses and containment within curbed and sumped area.

Began removal of contaminated chat in operating and loading areas.

Began storage of used and returned PCB's for eventual reworking or destruction by incineration.

Began change-out of Therminol heat transfer units in the plant.

MONITOR: Purchased and installed laboratory equipment to perform analyses in plant. Began routine plant analyses late in 1970.

1971

CONTAIN: Completed paving, cubing and installation of trenches in tank storage to contain accidental spills.

CONTROL: Completed the conversion of 16 Therminol heat transfer systems and 3 Pydraul hydraulic systems to non-PCB type fluids.

Discontinued transfer of department off-gas to Muriatic Acid operations where the carbon used to remove organics from the acid was discharged to the sewer after absorption of organics.

Installed facilities and started the manufacture of Aroclor 1016, a lower chlorinated more biodegradable Aroclor.

Equipment was installed to permit the incineration of liquid waste Aroclors. Complete incineration of the liquid waste is affected by incineration at 2000°F. Facilities are available for handling waste Aroclors from tank cars, tank trucks and drums.

Effluent streams from the disposal facilities are closely monitored to assure that knowing losses are controlled.

An installation permit has been received from the Illinois EPA for the Aroclor incinerator. The unit meets all requirements specified by the EPA, and the operations are monitored on a routine basis and reports sent to the EPA.

The incinerator area is paved, curbed and sloped such that all drainage within the area is directed to trenches and piping that flows to a 10,000 gallon settling basin. Recovered PCB's that are collected in the basin are periodically pumped to storage and subsequently incinerated.

In conjunction with the Incinerator, a program was implemented with the Evans Steel Barrel Company to properly cleanse and dispose of used drums that had once contained Aroclor. The initial procedure was to wash the incoming drums with kerosene to remove Aroclors, prior to additional washing and cleansing activities and resultant reconditioning. The spent kerosene and Aroclors were returned to WGK for incineration. This procedure was subsequently altered such that all drums pass through an incinerator to remove Aroclor prior to reconditioning.

MONS 042709

1971 (cont'd)

CONTROL: (cont'd)

Discontinued washing tank trailers outside plant confines where resultant trailer washes containing PCB's could get into outside effluent streams. Required that all trailers be washed at Repair Track under controlled conditions. Tank trailer washes along with tank car washes were stored in tank cars for subsequent proper water decantation and incineration of the waste PCB's.

MONITOR: Started intensive study to perfect the best sampling technique to monitor effluent streams for PCB's.

Operated continuous sewer samplers in Effluent streams from the plant and in the influent and effluent streams at the Sauget Waste Treatment Plant.

A plant Task Force was established to implement an effective loss control program to get PCB losses to below 1 pound per day from the manufacturing-incineration and repair track areas. Engineers from the Technical Services Department, the Maintenance Department and the Production Department made up the Task Force.

1972

CONTAIN: Completed installation of a second 3000 gallon settling basin and enlargement of an existing basin in the manufacturing department to insure PCB containment in case of accidental spill or equipment failure. All recovered PCB's are pumped into drums and subsequently incinerated.

Replaced major underground sewers with above-ground sewers and made major sewer repairs and replacements to eliminate build-up and cross flows of underground PCB contaminated waters.

Tank car wash facilities were installed at the Repair Track Area to permit settling of liquid Aroclors from the wash water before discharging the wash water to the sewer. This permitted discontinuing the previous practice of collecting, storing and recovery of material from the washing facilities. Reduced loss potential resulted from the loss handling required.

CONTROL: Production operations between the chlorosulfonic operations and the Aroclor operations were coordinated to minimize sewering HCl off-gas containing PCB's.

Provided nitrogen blanketing on storage tanks to eliminate any "breathing" of the tanks and resultant PCB escape.

1972 (cont'd)

CONTROL: (cont'd)

A process amendment was demonstrated to permit discontinuing the aeration step in the process by substituting more lime for neutralizing acidic process streams. This will permit reduction of a water scrubbed gas stream containing PCB and discharged to the sewer. Equipment has been purchased and the project is currently being installed in February, 1974 to permit implementation of the process amendment.

Facilities were installed within the manufacturing area for repairing contamination equipment. All equipment can be cleaned within padded and sumped areas where PCB's can be controlled within departmental limits.

An HCl off-gas scrubber design was completed to permit a major reduction in PCB's in the scrubbed gas. Departmental facilities were later installed and will be started in the first quarter of 1974.

MONITOR: A specially designed isokinetic continuous sewer sampler was installed in the manufacturing department for accurate monitoring of the effluent stream.

All process waters from the department plus the overflow from the settling basins enter the plant sewer system at one point. The entire stream (200 to 300 GPM) passes through a Parshall flume where the quantity is totalized by related installed instrumentation. Continuous flow recording is provided. A continuous sample of the department effluent is taken at the Parshall flume. The effluent sample is analyzed twice a week and PCB losses are calculated from the flow measurements and laboratory analyses. The loss data trends are reviewed by the Technical Services Department, the Environmental Control Group and department supervision to determine what corrective actions need be taken, if any, to restrict knowing losses to the lowest achievable level.

Within the Incinerator area all process waters from the area plus the overflow from the settling basin enter the plant sewer system. A continuous sample is taken from the effluent stream from the incinerator area. The effluent sample is analyzed twice a week and PCB knowing losses are calculated from an estimated flow rate and laboratory analysis. The loss data is reviewed to determine what corrective action need be taken, if any, to restrict knowing losses to the lowest achievable level.

1973

CONTROL: Extensive education and housekeeping effort is a "way-of-life" in the operating area. We have conducted an extensive education program with our operating personnel to emphasize - and re-emphasize the need for control and containment of PCB's within the department.

Much of the success of our efforts depends on maintaining a high housekeeping level in the department. Below is a listing of the kinds of housekeeping responsibilities our operators have assumed:

All pumps are checked for leakage on every shift. Drip pans that collect leaks are emptied into scrap Aroclor drums.

All leaks are reported and documented so that corrections can be made and settling basins observed.

"Floor Dry" is used to absorb any liquid Aroclor that has spilled or leaked. If it becomes necessary to flush PCB's to the settling basin, a minimum amount of water is used.

Sampling drums and scrap-Aroclor drums are quickly palletized, labeled, and transferred to the incineration area.

A project was installed to permit control of the HCl off-gas system such that any gas that may contain PCB's are not inadvertently sewered at Dept. 236.

Major effort was directed to reduce the drum storage containing returned Aroclors for disposal by incineration.

Off-gas scrubber installation in progress.

MONITOR: Intermittent sampling of various plant streams were conducted at various times to identify other potential loss areas outside the manufacturing-incinerator areas. Also, intermittent sampling conducted to better define "background" losses.

"Background" losses are those losses that had occurred in the past and have since permeated into the ground and are currently being leeched into the plant sewer system and are measured along with current losses at the Sauget Waste Treatment Influent stream.

V. Development and Implementation of Automatic Stream Sampling Stations

During the past three years the sampling technique to monitor effluent streams for PCB's has been under constant study and change. Monitoring effluent streams is not an easy effort. PCB's have the tendency to absorb on any solid present and the solubility of PCB in water is in the parts per billion range.

It is extremely difficult to obtain a continuous representative sample unless special facilities are installed.

Efforts in the past have been related to:

A. Obtaining data profiles along lengths of sewer mains.

B. Obtaining data traverses at cross sectional areas in sewer lines and sewer boxes.

C. Effect of sampler speeds on data.

D. Isokinetic velocity studies in sampler lines and stream flows.

E. Sewer sampling facilities and flow instrumentation provided.

We have learned that

A. Filtration of the sample will remove 70-90% of the PCB's present.

B. Sample data profiles along lengths of sewer mains can vary as much as 5:1 - 20:1 because of incomplete mixing in the line and the failure to get a representative sample.

C. Sample data traverses at cross sectional areas can vary as much as 2:1 - 400:1 for the same reason as listed above.

D. Of the four types of samplers we have studied, results can vary as follows:

1.	Flow speed samplers	Low results
2.	Fast speed sampler	High results
3.	Isokinetic samplers)	In between
4.	Grab sampler)	

Through exhaustive study, we feel we have installed the best sampling facilities and flow instrumentation, so we can continuously and accurately sample the effluent stream from the manufacturing area and determine any PCB content in it.

VI. Loading and Shipping Safeguards

A. In the Plant

During loading operations, we follow very specific operating procedures, based on very specific written instructions, to prevent accidental spills. The same is true for filling drums.

All loading and drum-filling operations take place in areas where drains and sewer systems are connected to settling basins.

B. Aroclor in Transit

For additional insurance, we have substituted a safer drum for shipping Aroclors. The metal thickness was increased by 26% (18-gauge drum to 16-gauge drum), and double chimes were added to give strength to the heads.

In addition, we have added specific instructions to our Aroclor labels, as follows:

> This product contains POLYCHLORINATED BIPHENYLS (PCB's) which some studies have shown may be persistent, an environmental contaminant and, possibly, injurious to certain forms of bird, aquatic and animal life.
> PREVENT ANY ENTRY INTO THE ENVIRONMENT THROUGH SPILLS, LEAKAGE, DISPOSAL, VAPOURISATION, RE-USE OF CONTAINERS OR OTHERWISE.
> SPILLS, LEAKAGES AND WASTE PRODUCT MUST BE COLLECTED.
> Use of this product must be restricted to applications in which it cannot come into contact with food, animal feedstuffs or pharmaceuticals.
> HARMFUL SUBSTANCE IF TAKEN INTERNALLY OR IF IN PROLONGED CONTACT WITH THE SKIN,
> CAUSES IRRITATION OF SKIN AND EYES.
> DURING SHIPMENT AVOID SPILLS AND LEAKAGE INTO INLAND WATERWAYS AND THE SEA.
> Store away from food, animal feedstuffs and pharmaceuticals.
> Keep container tightly closed.
> Do not eat or smoke when using.
> Avoid breathing vapours, mist or fumes.
> Do not wear contaminated clothing.
> Wash product from skin with soap and water.
> Wash eyes by flushing with water.

VI. Loading and Shipping Safeguards (cont'd)

B. Aroclor in Transit (cont'd)

Aroclor labels (cont'd)

WASTE DISPOSAL

With prior Monsanto notification used polychlorinated biphenyl fluids may be returned freight prepaid for proper incineration at 3¢ per pound.

Ship to: Supervisor Dept. 831
MONSANTO COMPANY
SAUGET, ILLINOIS 62201

VII. Current Known and Unknown Losses

A. Department 246 (Aroclor Manufacturing)

1. Aeration step in process contributes on the average about 0.8#/day. This will vary considerably depending on ambient temperature and the type of Aroclor being produced. Calculated losses range from 0.5 - 1.5#/day.

2. Settling basin losses are normally under 0.1#/day. At 3 GPM and 540 ppb solubility the loss can be as low as 0.02#/day.

3. The HCl off-gas from the Aroclor operations can contain from 15-30#/day PCB's. These losses are calculated losses and measured losses are somewhat less. When operating in conjunction with the chlorosulfonic acid department all PCB's are converted to a sulfonated compound in the chlorosulfonic acid scrubber. Consequently, the PCB's are changed to a different chemical compound which is subsequently sewered.

Intermittent discharge of HCl off-gas to the sewer at the Aroclor Department or inadvertently at Dept. 236 can result in losses to the sewer.

(Projects are being or have been installed to substantially reduce the possibility of losses from this area).

VII. Current Known and Unknown Losses (cont'd)

B. Incinerator

1. Scrubber water discharge from the combustion gas clean-up can result in the discharge of about 0.02 - 0.15#/day. Would normally expect about 10 ppb in 150 gpm water flow (≥0.02#/day).

2. Settling basin losses are essentially nil. Should be under 0.1#/day.

C. Repair Track - Whereas losses in the past could range from 0.02 - 1+ lb/day per tank car wash, we have since discontinued washing tank cars and tank trucks at the repair track. Past losses from this area were significant in that we may have washed a dozen or more cars per month.

D. Background - Represents losses in the entire sewage system that by some way enter the effluent streams from the plant and are present in the Waste Treatment Plant influent and are above those we know are entering the system at known or suspected locations. Aroclors have been produced at the W. G. Krummrich Plant since the early 1930's and losses that have saturated the plant areas contribute to todays "background". It is guesstimated these losses to be the equivalent of 5#/day. A gradual decrease with time is expected.

VIII. Present Levels in our Environment

A. The EPA has obtained samples at the Sauget Waste Treatment Plant influent and effluent streams. On all occasions the samples that are obtained are split and we receive a similar sample for our analysis.

Tabulated below are our analyses of these samples. We do not have any information with regard to the EPA analysis of similar samples.

					Equivalent
1/25/72	Waste	Treatment	Influent	471 ppb	60#/day
	"	"	Effluent	122	16
2/1/72	"	"	Influent	373	48
	"	"	Effluent	191	25
9/20/72	"	"	Influent	117	20
	"	"	Effluent	24	4
10/4/72	"	"	Effluent	34	6

VIII. Present Levels in our Environment (cont'd)

Unfortunately the early samples were atypical because normal results are much below these values. However, during the 2/1/72 period we were producing a short run of a mono chlorinated product and during this time it had been necessary to sewer all the off-gas from the manufacturing department.

B. Well Water - Past results vary from <1 - 33 ppb.

C. Cooling Tower - None detected by our routine laboratory method that will detect down to 10 ppb.

D. City Water - None detected by our routine laboratory method.

0.05 - 0.08 ppb by special analysis using a recently developed laboratory technique to measure low values.

E. Mississippi River -

At Chain of Rocks	0.22 ppb
Above confluence of Illinois	0.19
Missouri at St. Charles	<0.05
Illinois River	<0.25
At J.B. Bridge	<0.07

Sample taken in 1972 at various times and sample sizes. Would need much more data to draw conclusions. However, some values are above one time goal of EPA Task Force of 0.01 ppb in water.

F. Fish Data (1972)

1. Two each of four species of fish were taken from the Mississippi River about 15 miles south of the WGK plant. The PCB content in the edible portion ranged from 3 to 34 ppm.

2. Four fish of one species were taken from the Mississippi River about 100 miles north of the WGK plant. The PCB content in the edible portion ranged from 0.07 to 0.3 ppm.

Downstream fish are above the FDA guidelines of 5 ppm. However, the fish we obtained are not unlike fish taken throughout the United States with regard to PCB content.

The interdepartmental Task Force on PCB's report "Polychlorinated Biphenyls and the Environment" report fish data as follows:

1. Fish taken from 47 of 50 sampling stations in 1969 ranged from <0.1 to 15 ppm.

2. Of 40 fish analyzed from several rivers in 1970, the top 20 averaged 36 ppm with range of 10 to 213 ppm. Only 1 of the 40 was <1 ppm.

VIII. Present Levels in our Environment (cont'd)

F. Fish Data (1972) (cont'd)

3. Samples from 317 fish taken from 13 metropolitan areas (not St. Louis) taken from Nov., 1969 to June, 1971 were in the general range of 1 to 10 ppm. Varied from trace quantities to 35 ppm.

4. Catfish from commercial fish farms at 3 ppm.

IX. Future Activities

A. Goals and timing can be expressed in the following table.

Sources	Present	Goal I	Goal II
Department Losses Dept. 246 Incinerator	1.5#/day	<1#/day	<1#/day
Other Plant Losses	( )	0#/day	0#/day
Background Losses	( )	( )	2#/day
Total Losses to Sauget Waste Treatment Plant	10#/day	( )	3#/day
Total Losses to River	5#/day	( )	<1#/day
EDC	--	1/1/75	4th Qtr '75 (Dependent on completion of Chemical Treatment Plant)

B. Actions required to attain goals as follows:

1. Goal I (Department losses <1#/day)

CONTAIN: Upgrade sump at Incinerator area to better recover PCB's that collect in the 10,000 gallon sump.

Expand existing drum pad and provide additional curbs in Incinerator Area.

CONTROL: Start and demonstrate off-gas scrubber in Aroclor Department.

Eliminate aeration step in the continuous process in Aroclor Dept. Project being installed at present.

B. Actions required to attain goals as follows: (cont'd)

1. Goal I (cont'd)

MONITOR: Improve sampling pick-up and facilities at Incinerator area.

Monitor cooling water systems in Aroclor department to discover equipment failure with possible resultant discharge of PCB to department effluent streams.

Develop statistical data analysis technique to better spot out-of-control condition in Aroclor and Incinerator area.

2. Goal II (Other Plant Losses - 0#/day)

CONTROL: Institute a procedure to control handling of returned drums to eliminate losses within the plant.

Discontinue tank car and tank trailer washing operations at Repair Track area.

Continue present housekeeping practices in department and throughout the plant with regard to containment of PCB's.

Determine effect of PCB's that are presently sulfonated in the chlorosulfonic acid scrubber.

MONITOR: Develop statistical data analysis technique to better detect loss trends and assist in definition of "background" losses.

Continue the HCl off-gas header control to virtually eliminate possibility of inadvertently sewering gas at Dept. 236.

3. Goal III (Losses to River - $<$1#/day)

A. Background losses must be identified.

B. Laboratory experiments must be performed to predict the expected reduction in PCB's that will be possible in the soon-to-be installed Chemical Treatment Plant at the Sauget Waste Treatment Plant.

C. Develope and implement required additional actions.
   1. Clean sewers
   2. Repair and replace portions of plant sewer system where necessary.
   3. Remove contaminated chat and soil throughout the plant where necessary.