DIELECTRICS PRESENTATION TO CAC

I. ACTION SECTION

A. Situation

(SLIDE #1)

1. Monsanto has been under increasing pressure by the government, as well as concerned individuals, to terminate production of polychlorinated biphenyls (PCB's). Starting in 1970, PCB's have been sold exclusively into closed electrical systems -- capacitors and transformers -- but this policy has not quieted our critics.

2. On January 14, 1976, Jack Fitzgerald told Russell Train, Administrator of the EPA, that Monsanto had no desire to remain in PCB manufacture any longer than the period of time necessary for our customers to select acceptable alternate dielectric fluids.

3. We have offered non-PCB replacement fluids for use in capacitors and in transformers which have now been fully evaluated by our customers.

MONS 045050

B. RECOMMENDATION

1. Monsanto terminate its technical program on PCB replacement fluids as our specialty blends have been judged non-competitive with the commodity chemical alternates selected for use by our major customers.

2. A date for PCB shut-down will be established as soon as possible (selection made by August, 1976) consistent with our customer obligations in permitting them a minimum retrofit period. Probable date now appears to be on or before December 31, 1977.

3. Functional Products Business Group resources currently dedicated to the dielectrics business will be reallocated to growth products as selected by division management.

(SLIDE #1) C. ACTION REQUESTED

Advise the CAC of the Business Direction now underway with this comparatively high profile product.

II. BACKGROUND SECTION

A. FACTS BEARING ON THE PROBLEM

(SLIDE #2) 1. PCB production commenced at Anniston in 1929 and volume built to a high of 85M pounds in 1970. The policy decision to restruct sales to closed electrical systems then cut our volume roughly in half, dropping to 45M in 1971.

2. 1976 Estimated sales will be down to 27M pounds reflecting the continuing move away from PCB's. During the 47 year span between start-up and today, approximately 1.4 billion pounds have been produced in the U.S. by Monsanto.

(SLIDE #3)

3. It should be pointed out that we successfully retained most of the non-electrical markets from which PCB's were withdrawn. The fluids products involved were reformulated using existing alternates from within MIC. Lost volume was basically restricted to Plasticizers where suitable replacements were not feasible. We've held on to the 28M pounds of PCB based fluids which include heat transfer fluids -- Therminols -- hydraulic fluids -- pydrauls -- and carbonless copy paper solvents -- Santosols.

(SLIDE #4)

4. Monsanto has been working hard on PCB replacement products for several years. In November, 1975, a Task Group was formed to plan our withdrawal. Part of that planning included selection of the candidate with the highest odds of success which best meet the criteria of: (a) electrical properties; (b) acceptable fire risk; (c) environmental acceptability; and (d) a close plug-in for PCB's to minimize customers retrofitting. And, of course, we, as a minimum, wanted to maintain our current $4M performance income generation with a proprietary product.

MONS 045052

5. As GE's Hudson River problems mounted, they urgently requested we prepare a proposal to commercialize our selected replacement product called MCS 1238.

6. As Russel Train sounded the environmental alarm on PCB's and met with industry representatives to discuss the problems, we prepared a proposal for GE to supply sufficient product to satisfy both their, and the total U.S. capacitor industry's needs for a replacement product.

7. That proposal and our replacement product has since been rejected.

8. To better understand why we failed, let's take a look at the marketplace.

(SLIDE #5) The dielectric fluid market breaks roughly into two parts: two-thirds consumed in capacitors and one-third used in transformers. Let's look first at the U.S. capacitor market:

a. Remember that a capacitor is a device to store an electrical charge.

b. The dielectric fluid separates the two electrodes within the capacitor, assisting as well in the energy storage function.

c. PCB's possess an excellent ability to store energy, are very fire resistant, and have a very long functional life. However, the

very thing that makes PCB's so fire resistant makes them unacceptable to the environment because they accumulate instead of degrade.

d. Aroclor 1016 is a 20M lb. market today. Our replacement candidate is called MCS 1238 and is a blend of a biphenyl derivative and a sulfone. This blend has a replacement value which would permit almost 25% less poundage being needed or roughly 16M lbs.

e. GE has an estimated 44% market share and is almost four times the size as their nearest competitor, Westinghouse.

f. The end-use market for capacitors is:
-- 50% motor run primarily major appliances
-- 25% lighting, both fluorescence and street
-- 25% power, for use in transmission lines.

9. GE evaluated our proposal, looked at their alternates and came up with the following conclusions:

(SLIDE #6)

a. GE can make acceptable capacitors with DOP to serve all markets.

b. If GE can do it, their competitors will learn the technology to do likewise.

c. The capacitor market historically has been extremely competitive low growth and low profit and will remain that way.

MONS 045054

d. Some fragmentation to several available commodity chemical alternates will be inevitable.

e. Therefore, GE must suggest a commodity chemical solution to PCB's.

10. The fundamental point here is that once you back off the superior performance of PCB's, particularly their fire resistance, price becomes a dominant criteria for alternate selection. If there was a major flaw in our business planning for PCB withdrawal, it was in underestimating this point.

(SLIDE #7) 11. The rest of the industry, aware of GE's position due to GE's actions in the marketplace, reached the following conclusions:

a. DOP can be made to work in motor run capacitors.

b. If GE can make DOP work in power capacitors, others will try to do the same.

c. Fragmentation will take place in power capacitors including:

-- GE - DOP + Trichlorobenzene @ about 30¢/lb.

-- Westinghouse - MIPB or SAntosol 100 @ about 67¢/lb.

-- Sangamo - DOP @ 27¢/lb

-- McGraw -- DOW's fluid which was developed with McGraw's technical help and upon which many patents are jointly held. McGraw does admit their odds for success now are at best slim @ $2.00/lb.

NOTE: These prices compare with PCB's today at 60¢/lb and $1.20-$1.40/lb for our fluid MCS 1238.

(SLIDE #8) 12. Based on these conclusions as reached by our customers, we have now embarked upon the following course of action:

a. Have reviewed the phthalate ester opportunity with the plasticizer division, assisting them with our technical base.

b. Will offer Santosol 100 (currently sold to NCR as a carbonless copy paper solvent) to power capacitor producers.

c. Put our replacement candidates back on the shelf.

d. Redeploy our resources to growth projects within the division.

e. Reaffirm Monsanto's PCB withdrawal.

(SLIDE #9) 13. Now that we have reviewed the background, conclusion and business direction taken for the capacitor portion of our dielectric business, let's take a comparatively quick look at the transformer market:

a. The transformer business, you will recall, historically has accounted for approximately one third of our dielectrics sales in the U.S. We said that out of a 30M lb. PCB sales year, 10M lbs. would be sold into "Askarel" or fire retardant transformers. These would typically account for only five to seven percent of the total output of transformers produced in the U.S. annually.

b. Functionally, transformers are devices for converting power at one voltage to equivalent power at a different voltage. The dielectric fluids role is to insulate the electrical components from each other and to remove heat. Thus, good dielectric strength, heat transfer properties and fire resistance are the primary performance criteria.

c. Mineral oils are the most widely used transformer oil in non-fire risk applications. Air cooled also account for a substantial portion of the market as well. PCB or Askarel transformers would be ordered where the unit is either in the midst of or in close proximity to people such as apartment buildings, hospitals, factories, etc.

d. Keep in mind that the pressure to remove PCB's from capacitors has been more severe because:
   (1) they are the largest consumption area
   (2) GE's Hudson River plants are capacitor plants, and
   (3) transformers are more truly closed applications because these large units are not normally discarded into the environment.

(SLIDE #10) 14. The situation then was Monsanto developed the best replacement candidate we could for transformers based upon a blend of hydrocarbon (alkylated biphenyl and trichlorobenzene).

MONS 045057

Conclusions

(1) Our own fire tests (at Monsanto's fire lab in St. Charles) showed our fluid to have less fire resistance than PCB's, but also less than silicone.

(2) GE has said they could and likely would use straight TCB in their liquid filled fire resistant transformers.

(3) Transformer customers are moving rapidly away from Askarels by specifying air-cooled or oil-cooled units. PCB sales for new units are now projected to be near zero by early 1976.

(4) Liquid silicone can be used as a replacement fluid in existing PCB transformers.

(SLIDE #11) 15. Monsanto's course of action then is to:

a. Cease all work on formulation of non-PCB replacement transformer fluids.

b. Redeploy our resources to divisional growth projects.

c. Reaffirm Monsanto's PCB withdrawal.

III. SUMMARY

(SLIDE #12) A. In summary, let me stress that we are not lightly walking away from the dielectric fluids business. Technically as well as commercially, we believe we made every possible effort to replace our own products with Monsanto candidates. But the fact is clear that once the electrical industry stepped away from the excellent fire-resistance of PCB's, alternate products of higher fire-risk must compete on the basis of price. That criteria of price has led this industry to existing commodity chemicals.

(SLIDE #12) B. We do take some measure of accomplishment though in knowing that we have done three things we consider to be important:

1. We are getting the corporation out of the production of an environmental pollutant.

2. We are existing the business profitabily while covering all our phase-out costs.

3. We prevented what would have been, we believe, a serious capital mistake.

THANK YOU FOR YOUR TIME AND ATTENTION -- ARE THERE ANY QUESTIONS?

1. We are getting the corporation out of the production of an environmental pollutant, probably before the end of 1977.

2. We are exiting the business profitably while covering all our phaseout costs, both $800M of net investment and $73M of decontamination and dismantling costs AT OUR KRUMMRICH FACILITY.

3. We prevented what would have been, we believe, a serious capital mistake. Had we commercialized ~~just~~ the in-house manufacture of MCS 1238 and its raw materials, an estimated $10.5M of new fixed capital would have been SPENT ~~wasted~~. WITH THE SAME EVENTUAL MARKET MOVEMENT TO PHASE-OUT ESTERS TAKING PLACE ANYWAY.

THANK YOU FOR YOUR TIME AND ATTENTION -- ARE THERE ANY QUESTIONS?

MONS 045060

III. SUMMARY

SLIDE #12

A. In summary, let me stress that we are not lightly walking away from the dielectric fluids business. Technically, as well as commercially, we believe we made every possible effort to replace our own PCB products with Monsanto Replacement candidates. But, the fact is clear that once the electrical industry stepped away from the excellent fire-resistance of PCB's, alternate products of higher fire-risk must compete on the basis of price. That criteria of price has led this industry to existing commodity chemicals. While we have specifically discussed our U.S. business directions with you today, the inevitability of our European PCB production following this same ~~termination is perhaps~~ PHASE-OUT at perhaps a slower pace ~~is~~ is unavoidable.

B. We do take some measure of accomplishment though in knowing that we have done at least three things we consider to be important:

(INSERT)

OUR REASONS FOR SELECTING MCS-1238 AS OUR PCB REPLACEMENT ARE SUMMARIZED ON THIS CHART. —— LET'S REVIEW THE COMPARITIVE CHARACTERISTICS OF 1238 VS. AROCLOR 1016:

COMPARISON OF CHARACTERISTICS

	AROCLOR 1016	MCS 1238
FIRE RESISTANCE	EXCELLENT	FAIR, BUT HIGHER ...
ELECTRICAL PROPERTIES	EXCELLENT	EXCELLENT
ENVIRONMENTAL ACCEPTABILITY	POOR	GOOD
PATENT POSITION	FAIR	GOOD COMMERCIAL EMPLOYER
RAW MATERIAL POSITION	EXCELLENT BASIC IN BIPHENYL & CHLORINE	GOOD BIPHENYL PLUS SOME CHEMICALS
FIT WITH CUSTOMER'S FACILITIES	EXCELLENT	EXCELLENT IN ... WORDS, NO RETROFITTING
COSTS	60¢/LB	$1.20/LB (EQUIVALENTLY 90¢/LB) WITH A 3/4 RATIO REPLACEMENT

MONS 045062

a. Have reviewed the phthalate ester opportunity with the plasticizer division, assisting them with our technical base.

b. Will offer Santosol 100, which is benzylated ethyl benzene, currently sold to NCR as a carbonless copy paper solvent to power capacitor producers.

c. Put our replacement candidates back on the shelf.

d. Redeploy our resources to growth projects wtihin the division.

e. Reaffirm Monsanto's PCB withdrawal.

Our candidate: (1) was designed as a plug-in for PCBs in existing, as well as new, Askarel transformers; (2) was believed to be environmentally acceptable; (3) was designed to cost only fractionally more than today's PCBs; (4) could be produced with low level new capital; and (5) was based upon existing Monsanto raw materials.

f. The end-use market for capacitors is:

-- 50% motor run primarily major appliances

-- 25% lighting, both fluorescence and street

-- 25% power, for use in transmission lines.

SLIDE #5A INSERT

9. The Monsanto/G.E. MCS 1238 Proposal was as follows:

Price @ $1.20/lb

Volume @ 4M lbs./year for 3 years

Liquidated Damages STARTING @ $3M, declining over 3 years to zero.

This PROPOSAL was developed to generate for Monsanto ~~$3M/year~~ #3M per yr PI ~~DI~~ which would yield 23% net income return on investment ONCE VOLUME REACHED 70% OF CAPACITY

SLIDE #6

G. E. evaluated our proposal, looked at their alternates and came up with the following conclusions:

a. G.E. can make acceptable capacitors with DOP to serve all markets, thereby saving 60¢/lb. versus our candidate.

b. If G.E. can do it, their competitors will learn the technology to do likewise.

c. The capacitor market historically has been extremely competitive, low growth, and low profit and will remain that way.

d. Some fragmentation to several available commodity chemical alternates will be inevitable as we will illustrate shortly.

e. Therefore, G.E. must select a commodity chemical solution to PCB's to STAY COMPETITIVE LONG-TERM

10. The fundamental point here is that once you back off the superior performance of PCB's, particularly their excellent fire resistance, price becomes a dominant criteria for alternate selection. If there was a major flaw in our business planning for PCB withdrawal, it was in underestimating this point.

SLIDE #7

11. The rest of the industry, aware of G.E.'s position due to G.E.'s actions in the marketplace, reached the following conclusions:

a. DOP can be made to work in motor run capacitors.

b. If G.E. can make DOP work in power capacitors, others will try to do the same.

c. Fragmentation will take place in power capacitors including:

-- G.E. - DOP + Trichlorobenzene @ about 30¢/lb.

-- Westinghouse - MIPB or Santosol 100@ about 67¢/lb.

-- Sangamo - DOP @ 27¢/lb.

-- McGraw - DOW's fluid which was developed with McGraw's technical help and upon which many patents are jointly held. McGraw does admit their odds for success now are at best slim @ $2.00/lb.

NOTE: These prices compare with PCB's today at 60¢/lb and $1.20/lb for our fluid MCS 1238 which would equivalently cost 90¢/lb.

SLIDE #8

12. Based on these conclusions reached by our customers, we have now embarked upon the following course of action:

d. Keep in mind that the pressure to remove PCB's from capacitors has been more severe THAN IN TRANSFORMERS because:

(1) CAPACITORS are the largest consumption area;

(2) G.E.'s Hudson River plants are capacitor plants; and

(3) transformers are more truly closed applications because these large units are not normally discarded into the environment.

SLIDE #10

14. The situation then was Monsanto developed the best replacement candidate we could for transformers based upon a blend of hydrocarbon (alkylated biphenyl) and trichlorobenzene).

CAPACITOR DIELECTRICS BUSINESS DIRECTION

MONS 045068

G. E. CONCLUSIONS

1. G. E. CAN MAKE ACCEPTABLE CAPACITORS WITH DOP TO SERVE ALL MARKETS.
2. SINCE G. E. CAN DO THIS, THEY ARE SURE THAT OTHERS WILL ALSO LEARN PURIFICATION AND ADDITIVE TECHNOLOGY.
3. HISTORICALLY, THE CAPACITOR MARKET HAS BEEN A PRICE COMPETITIVE AREA WITH LITTLE GROWTH AND LOW PROFIT.
4. FRAGMENTATION IS INEVITABLE.
5. G. E. MUST SUPPORT COMMODITY STRATEGY.

MONS 045069

CONCLUSIONS - REST OF INDUSTRY

(AWARE OF G. E. COMMITMENT TO DOP APPROACH)

MOTOR - DOP CAN BE MADE TO WORK.

LIGHTING- G. E. MAY BE ABLE TO USE DOP.

- OTHERS WILL TRY TO MAKE ESTER WORK.
- IF THEY FAIL, COULD WISH TO COMMIT TO ~ 2.0 M LBS. MCS 1588.

POWER - COMPLETE FRAGMENTATION

G. E. - DOP + TCB (~30¢)

WESTINGHOUSE - MIPB OR SANTOSOL 100 (~67¢)

SANGAMO - DOP (~ 27¢)

MCGRAW - DOW XFS4169L (~$2.00)

MONS 045070

MONSANTO CONCLUSION

AFTER PCB PHASE-OUT, U. S. INDUSTRY WILL USE:

A. ~15 M LBS. OF PHTHALATE ESTER, ($4.5 M) CURRENT CONTENDERS

EXXON - DINP
GRACE - DOP.

B. ~2 M LBS. OF HYDROCARBON ($1.4M)

MIPB - SUN/PILOT
SANTOSOL 100 - MONSANTO.

C. IF ESTERS FAIL AT HIGHER TEMPERATURES (>75°C.) AND HIGHER VOLTAGES, THERE COULD BE A NEED FOR ABOUT 3 M LBS. MCS 1588.

COURSE OF ACTION

1. A. FUNCTIONAL PRODUCTS REVIEW PHTHALATE ESTER OPPORTUNITY WITH PLASTICIZER DIVISION.

   B. IF PLASTICIZERS HAVE POSITIVE INTEREST IN THIS MARKET, USE OUR TECHNICAL INPUT TO BUILD A BASE FOR PLASTICIZER SALES.

2. OFFER SANTOSOL 100 TO POWER CAPACITOR INDUSTRY (FROM FUNCTIONAL PRODUCTS TO SUPPORT EXISTING PRODUCT SALE TO CARBONLESS PAPER MARKET).

3. PUT MCS 1238/1588 DEVELOPMENT ON SHELF.

4. REAFFIRM MONSANTO PCB WITHDRAWAL (INCLUDING AROCLOR 1016).

MONS 045072

SITUATION

MONSANTO DEVELOPED A CANDIDATE PCB REPLACEMENT TECHNOLOGY FOR TRANSFORMERS BASED ON BLENDS OF HYDROCARBONS AND TRICHLORBENZENE.

1. OUR FIRE TESTS SHOW POOR FIRE RESISTANCE OF OUR FLUID COMPARED TO PCB AND SILICONE.

2. IF G. E. DECIDE TCB IS SAFE TO CONSIDER FOR THE FUTURE, THEY WILL USE TCB ALONE IN 90% OF THEIR PRODUCTION.

3. TRANSFORMER CUSTOMERS ARE MOVING RAPIDLY IN 1976 TO SPECIFICATION OF AIR-COOLED OR OIL-COOLED ALTERNATIVES. PCB SALES FOR NEW UNITS WILL FALL TO ZERO EARLY IN 1977.

4. LIQUID SILICONE CAN BE USED AS A REPLACEMENT FLUID IN EXISTING ASKAREL (PCB) TRANSFORMERS.

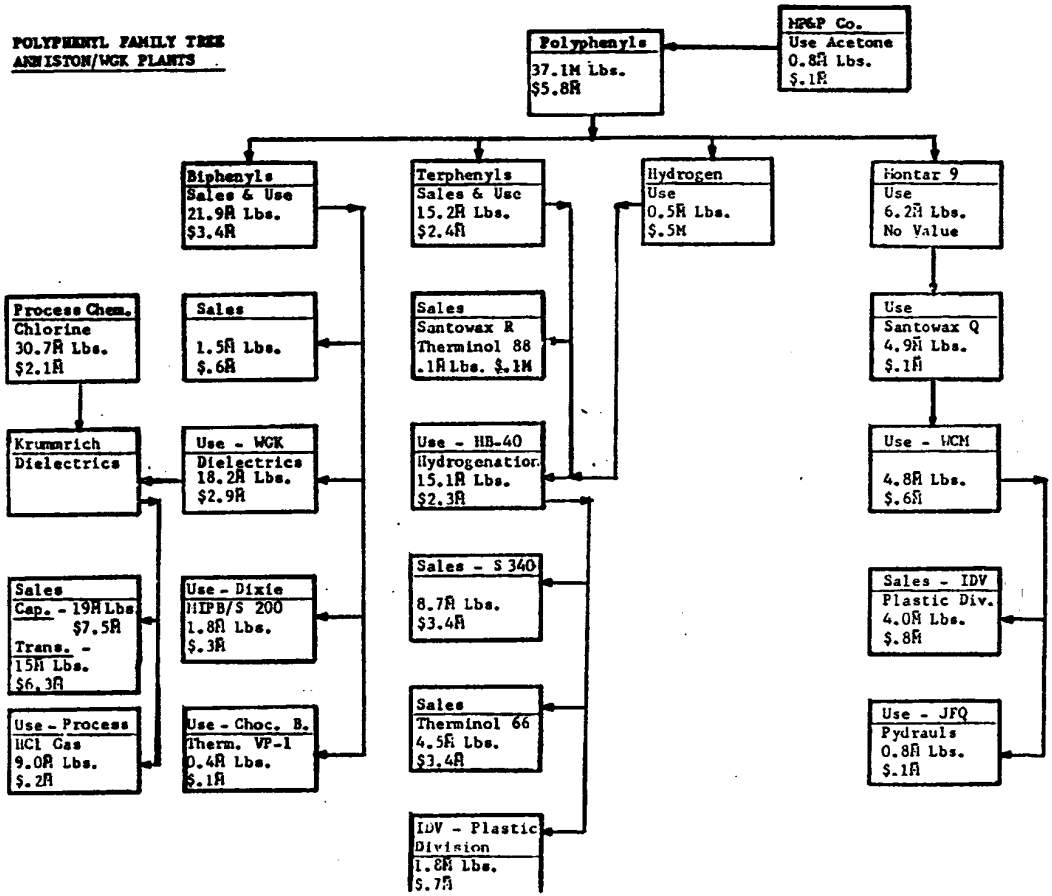
MONS 045073

COURSE OF ACTION

CEASE ALL WORK ON FORMULATION OF NON-PCB REPLACEMENT TRANSFORMER FLUIDS.

MONS 045074

POLYPHENYL FAMILY TREE
ANNISTON/WGK PLANTS



MDNS 045075

MONSANTO REPLACEMENT FLUIDS

CAPACITORS

MCS 1238 = MIPB (MONOISOPROPYL BIPHENYL) + TXS (TOLYL XYLYL SULFONE)

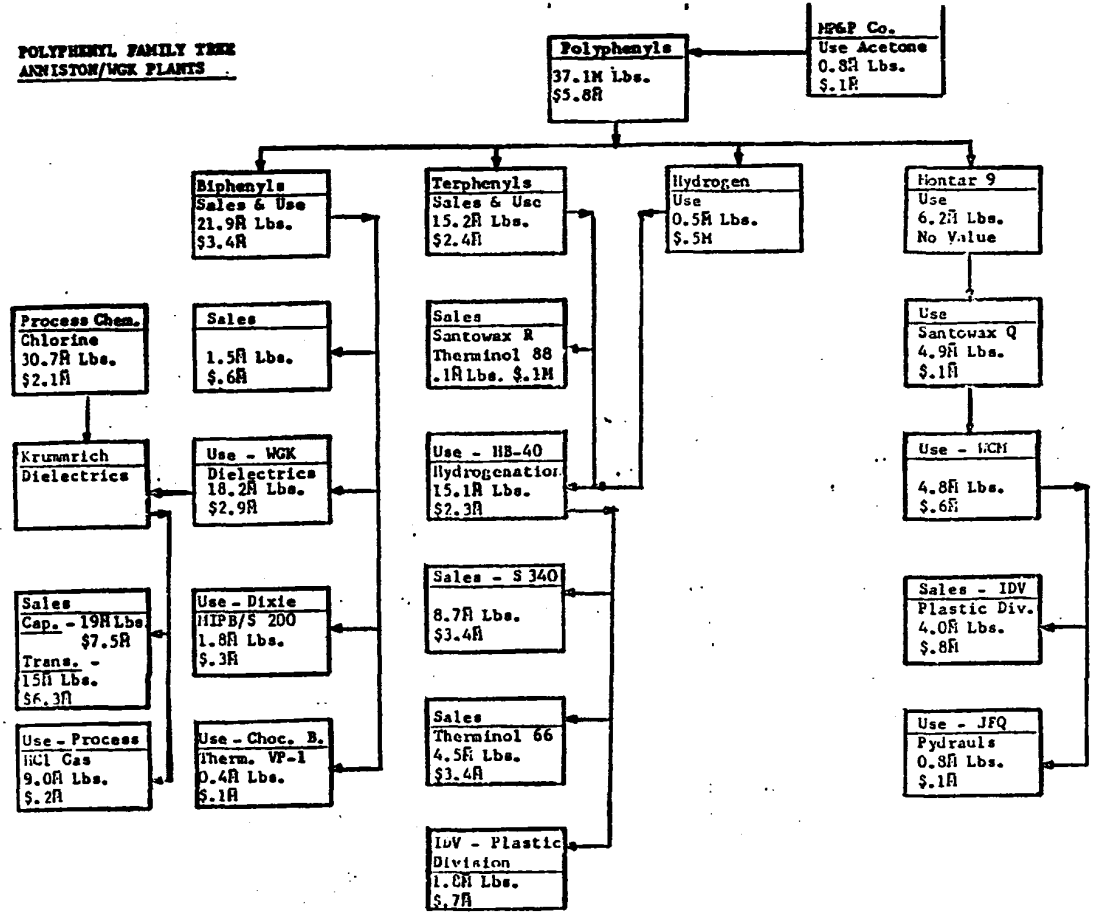
MCS 1588 = SANTOSOL 100 (BENZYL ETHYL BENZENE) + TXS (TOLYL XYLYL SULFONE)

TRANSFORMERS

MCS 1839 = ALKYLATED BIPHENYL

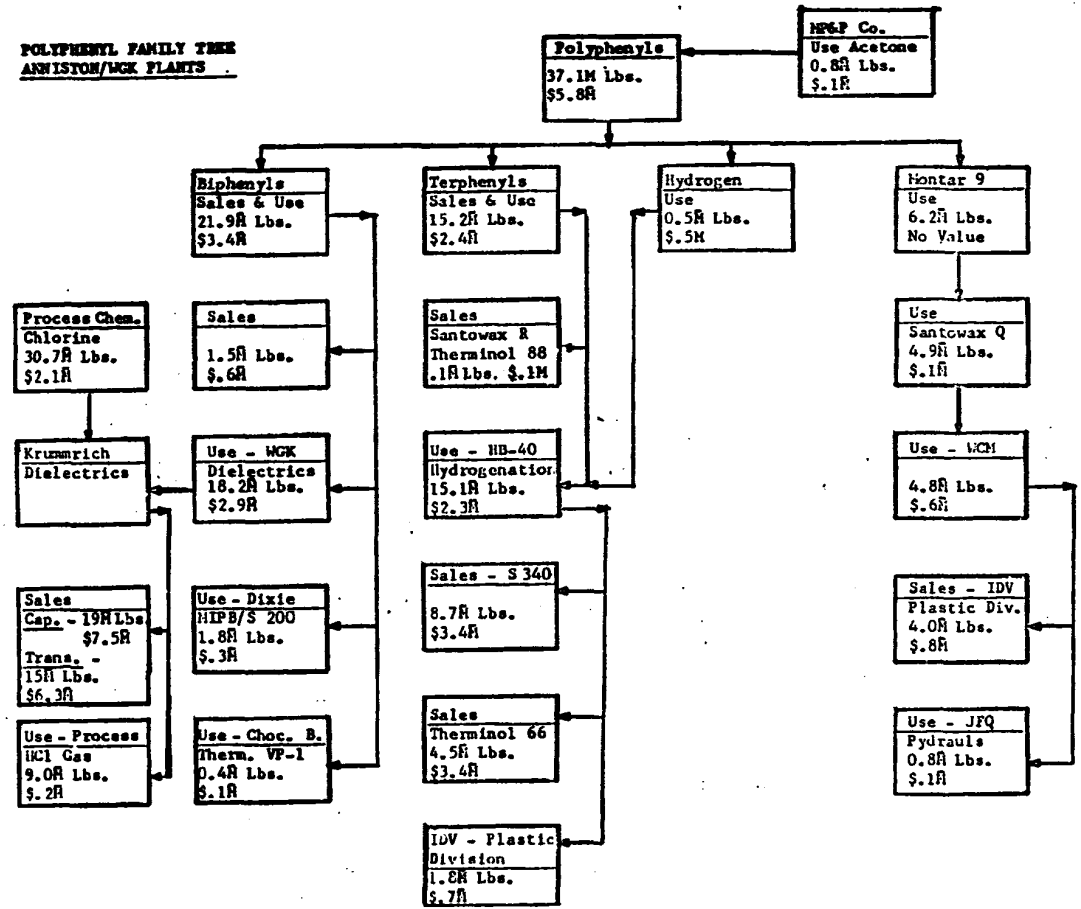
MCS 1866 = ALKYLATED BIPHENYL + TRICHLOROBENZENE

POLYPHENYL FAMILY TREE
ANNISTON/WGK PLANTS



MONS 045077

POLYPHENYL FAMILY TREE
ANNISTON/WGK PLANTS



MONS 045078