R+D Budgets 1972

D. SPECIALTY PRODUCTS

1. Functional Fluids

Resistance of higher chlorinated biphenyls to biodegradation and their biological activity similar to low-levels of pesticides have dictated substantial changes in Aroclor technology and marketing. We have installed a high-temperature incinerator to destroy chlorinated biphenyls. We need new capacitor fluids. The first of these will have minimal amounts of the refractory penta- and hexachloro isomers which we eliminate by fractional distillation of Aroclor 1242. A plant is due to start up in July. Anticipated follow-on products with greater biodegradability include dichlorobiphenyls and dichlorophenyl ethers. Non-halogen capacitor fluids based on phenyl sulfones, phenyl ketones and phenyl or biphenyl ethers are also being evaluated in capacitors. Such non-halogen fluids may be required by 1973-75 since government regulatory agencies are beginning to seek bans and control of polychlorinated biphenyl.

Direct control and ultimate incineration of Aroclor is our policy in transformer use. Reclaim and incineration processes are required. Products will be required in 1972-75 to replace the dollar volume we expect to lose because of inroads of hydrocarbon, potting and dry-type transformers. We have tested the first candidate hydrocarbon fluid, a by-product benzene alkylate stream, in electrical cable, in switch gear and in transformers.

General Electric has indicated the need for fire retardants in potting insulation for transformers. We have submitted halogenated terphenyls and quaterphenyls which could conceivably offset a decline in Aroclor transformer fluids in the 1972-1980 period.

We reformulated all Pydraul fluids in 1970-71 to reduce the release of chlorinated biphenyl to the environment. Present Pydraul fluids will need to be reformulated to phosphate esters in 1971-72 and to still more environmentally acceptable fluids in 1972-75. We are developing high-viscosity nonylphenyl and cumylphenyl phosphates to meet this need. They have low toxicity and reduce our reliance on cresylic acids. In the future still more biodegradable, less toxic fluids will be required. Esters and aliphatic polyethers are candidate base stocks. Recovery and reclaim of hydraulic fluids will be economically feasible and necessary in the 1970's.

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We need to replace Aroclor 1242 in NCR carbonless reproducing paper to meet present environmental pressures. Isopropylbiphenyl and HB-40 are the first candidate replacements. We are examining products made by alkylation and hydrogenation of aromatic 1-, 2- and 3-ring compounds, condensed and non-condensed structures. Shifting requirements are anticipated throughout the 1970's as improvements in dyes and resin systems are made by NCR and the paper manufacturers.

Fractionation of chlorinated biphenyls will yield useful intermediates - e.g., monochlorobiphenyl for use as a dye carrier by Geigy, as an intermediate for Dow and for our own hydrolysis to o-phenylphenol. Fully chlorinated biphenyl is desired as an intermediate by DuPont. We expect to build sales of chlorinated biphenyl and derivatives as intermediates to replace sales of chlorinated biphenyl as an "end-use" product, hopefully forestalling shut down of the Aroclor complex.

Halogenated terphenyls and quaterphenyls may be adaptable as fire retardants in fibers and plastics. We are supplying Aroclor 5468 and synthesizing highly brominated terphenyls and halogenated quaterphenyls toward this market need. The market is expected to develop from 1972-75 but will require new functional, non-extractable materials by 1975-80.

The capacity of the tube furnaces for biphenyl and terphenyl needs to be increased in 1972 to avoid investment in a third furnace. We have demonstrated 20% increased conversion by catalyst injection in a small reactor. Plant expansion in the biphenyl/terphenyl/quaterphenyl purification train is required in 1971.

We hope to use quaterphenyls in the 70's - in fact, may be forced into it. Hydrogenated quaterphenyls, undergoing electrical evaluation in plasticizer blends, may help relieve the terphenyl shortage.

Savings for 1971 are expected by higher conversions in the dibutyl phenyl phosphate process, self-manufacture of tributyl phosphate, solvent stripping of VI improver at Monsanto (freight savings and reduced base-stock losses).

Skydrol formulation changes in 1972-75 should improve shear stability, drag reduction, skin adsorption, fire resistance and wear properties. We shall formulate hydraulic fluids designed for the Concorde.

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Airport runway deicers represent a new opportunity for Monsanto to supply the aviation industry and government agencies. Non-ionic corrosion-inhibited amides prevent ice from forming down to 0°F. and aid in snow and ice removal to keep airports open. We have formulated an efficient, low BOD deicer. Self-manufacture or a favorable purchase arrangement for formamide and/or acetamide will be required to meet future profit requirements. Markets for chemical deicers are expected to build throughout the 1970's since control of ice by heating is inefficient and costly.

2. Cellu-Chem

Two new competitive products are being introduced to the paper sizing market - Hercules' Newphor 100 and National Starch's R-68, based on rosin acid and alkylsuccinic anhydride respectively. We need to develop rosin acid and alkylsuccinic anhydride dispersion technology to match these products. We have a lead to match R-68 in that our own polybutenylsuccinic anhydride (petroleum additive intermediate) exhibited sizing.

Tall oil for rosin-acid manufacture may no longer be available from our present supplier after the contract expires in 1972. Since tall oil and rosin quality will vary with each supplier, the tall oil to rosin and Mersize processes must be adapted.

Generally the efficiency of surface size applied at the size press is better than size applied at the "wet end". The consequence is a shrinking market for paper size as size-press applications increase. Participation in those market applications where size is required in the middle of the cellulose sheet, such as food-board stock, will be required to maintain sales volume. We need a "harder", less water-soluble, and more reactive size to compete in this market. Candidates are lacking at present. We need to match Aquapel in performance.

Monsanto has led the industry in the application of sizing and hold-out resins at the size press. The technical challenge is to improve product performance without increasing manufacturing costs. PP&R has demonstrated minimal handling and solvent losses in a "belt process" for SMA. This process will be required in 1972 and later to hold a competitive cost-performance position.

Polyamines made by treating ethylene dichloride and/or epichlorohydrin with hexamethylenediamine (nylon intermediate) are useful in imparting wet strength and in providing polycationic precipitation action in paper. They are also useful flocculating agents for water treatment. Key to further development is FDA approval.

Major growth in paper chemicals requires entering the converting field where excellent opportunities exist in large-scale, growing markets for polymer latices in printable coatings, packaging, disposable non-wovens, saturating resins and many specialties.

We have chosen to base our entry into these markets on a Monsanto-developed family of ethylene/vinyl chloride polymers. Our first products are proprietary terpolymer latices designed to meet specialty applications in the paper, printing-ink, non-woven, textile and carpet industries where they offer unique advantages. Our first plant (19M lbs.) is due on stream in August, 1971, and will require start-up, application research and technical service support to reach sales targets. We are also planning to develop a lower cost, continuous process for the next expansion. This will permit us to compete in the very large, low price market segments in the paper and other industries. The business target for 1980 is $30M SALES.

Product from the first plant will fit limited applications owing to economics of the plant and limited polymer properties available from it. The continuous process should allow us to make the low-modulus, rubbery polymers which are needed in the saturating and non-woven areas at lower costs. The low cost product should allow us to enter profitably the pigment-binder market. Our balance of properties makes E/VCl an ideal polymer for this application. Both crosslinkable and self-crosslinking polymers are needed. New fire retardance emphasis suggests opportunities for E/VCl polymers. A good balance of oxygen permeability and water vapor permeability offer opportunities for E/VCl films in the packaging area. Paint applications are attractive because of pigment-binding and low-water-sensitivity character.

Environmental pressures will restrict sales of pentachlorophenol to applications such as wood treating. However, we see no replacement product before 1975. An immediate problem is to reduce color and sludge formation in wood-treating oils. An

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ameliorating approach is with stabilizers and chelating agents whereas long-term we hope to provide the solution by improved processing. Government regulations expected before May 1, 1971, will limit allowable chlorinated dioxin content in Penta. Reason: to reduce teratogenic effects and chick edema. Separation of the dioxin by-products is proposed since we do not have process ability to limit its formation in the first place. Chemical alteration of the dioxin structure is also being considered.

Santobrite sales are expected to decline precipitously in 1971 owing to environmental pressures. We plan to introduce o-phenylphenol and lower chlorinated phenols as replacement products.

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TABLE VIII

ORGANIC CHEMICALS DIVISION
1971 TECHNICAL PROGRAM

Specialty Products Business Group

	Pre-SOI Net Research, $M			
	Actual	Budget	Projection	
	1970	1971	1972	1973
Diversification				
Ethylene Vinyl Chloride				
Can we launch our pigment binder project and build on ethylene/vinyl chloride technology by developing product and process variations and defining performance for application as saturating resins, non-woven binders, barrier coatings, carpet backing, elastomers?	480	534	400	400
Deicers				
Can we provide unique deicer compositions (for airport and highway use), with emphasis on proprietary corrosion inhibition, environmental compatibility and with a Monsanto raw material position?	20	40	50	50
Expansion				
Wet Strength/Retention Aid				
Can we develop a profitable position with our new paper-making additive based on Textile Division "amine residue" (and HMD) in the areas of wet strength and retention aids?			MONS	201224

(Cont'd.)

Specialty Products Business Group (Cont'd.)

	Pre-SOI Net Research, $M			
	Actual	Budget	Projection	
	1970	1971	1972	1973
Expansion (Cont'd.)				
Wet Strength/Retention Aid (Cont'd.)				
Will this help us penetrate the food board business by allowing us to work more efficiently with rosin acid > C_{18} fatty acids? Can we exploit our wet strength/retention aid products in other areas, e.g., waste water treatment?	140	60	280	300
Next Dielectrics				
Can we build on our present market position by developing fluids with better environmental acceptance and near equivalent cost/performance to those based on chlorinated biphenyl?				
Phosphate Ester Hydraulic Fluids				
Can we develop all-phosphate ester, fire resistance hydraulic and turbine lube fluids as profitable extensions of our phosphate ester technology, and as alternatives to fluids containing chlorinated biphenyls or chlorinated terphenyls? (We need to be aware of competitive phosphate esters and alternates to phosphate esters.)	135	80	80	50

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Specialty Products Business Group (Cont'd.)

	Pre-SOI Net Research, $M			
	Actual	Budget	Projection	
	1970	1971	1972	1973
Expansion (Cont'd.)				
Diphenyl Ether				
Can we acquire an economical technical position in diphenyl ether to broaden our heat transfer fluid line? Can we use diphenyl ethers as a base or a raw material for dielectric and industrial fluid formulations?	40	54	60	30
Regenerative				
Rosin Size/Surface Size				
Can we create process and property modifications to keep our Mersize and Scripsets technically competitive?	130	123	250	300
Pentachlorophenol/Santobrite				
Can we make Penta and Santobrite acceptable environmentally and also achieve a favorable quality/cost position with the new process? Can we find substitutes for Santobrite?	0	0	100	100
Aircraft Hydraulics				
Can we decrease the cost and improve the performance characteristics of our Skydrol fluids to maintain a technical competitive advantage particularly in the areas of low density, streaming potential, increased fire resistance, shaft seal performance, erosion resistance, thermal stability (low cost base stocks) and low cost formulations?	106	60	60	60

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Specialty Products Business Group (Cont'd.)

	Pre-SOI Net Research, $M			
	Actual	Budget	Projection	
	1970	1971	1972	1973
Regenerative (Cont'd.)				
Industrial Fluids				
Can we reformulate our industrial hydraulic and lubricant fluids to eliminate PCB's? Can we develop fluid recovery procedures for non-water based fluids? Can we formulate more biodegradable and acceptable hydraulic and lubricant fluids?	75	140	150	140
Encapsulants - Dye Solvents				
Can we provide alternate products to replace PCB's as encapsulant fluids and provide efficient manufacturing processes for these fluids?	60	56	60	60
Biphenyl Derivatives				
Can we develop new biphenyl/terphenyl/quaterphenyl intermediates and derivatives to replace polychlorinated biphenyls and build on our biphenyl family tree; di and poly-aromatics as fire retardants; substituted biphenyls as dye carriers?	20	81	100	100
Fluids Environmental Defense				
Can we defend against law suits and prevent contamination of the environment with Aroclor products and with new replacement products and formulations?	220	145	180	200

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Specialty Products Business Group (Cont'd.)

	Pre-SOI Net Research, $M			
	Actual	Budget	Projection	
	1970	1971	1972	1973
Regenerative (Cont'd.)				
Heat Transfer Fluids				
Can we provide expert heat transfer system design and technical support for our Therminol fluids?	30	20	30	40
Dielectrics				
Can we develop variants of our present biphenyl based products to maintain our profitable participation in the dielectric market in view of the PCB environmental problem?	100	90	100	50

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TABLE IX

SPECIALTY PRODUCTS MANPOWER REQUIREMENTS

TECHNICAL PROGRAM Business Group: Specialty Products	MAN-YEARS PER YEAR										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Diversification											
Deicing Materials	1	1	1	1	1	1	2	2	2	2	2
Solid Insulations, Dielectrics	-	-	1	1	2	2	3	3	3	3	3
Synthetic Hydrocarbons - New Industrial Fluids	-	-	1	2	2	2	3	3	4	4	4
E/VCl - Batch Process Derived Latexes	15	11	8	8	8	8	8	8	8	9	10
E/VCl - Continuous Process Derived Latexes and Solid Polymers	-	-	10	11	11	6	4	4	4	4	4
Polycation Water Clarification	-	-	2	2	2	2	2	2	2	2	2
Total Diversification	16	12	23	25	26	21	22	22	23	24	25
Expansion											
Advanced Skydraul and Lubes	1	1	2	2	3	3	4	4	4	4	4
Next Generation Dielectric Fluids	2	2	2	2	2	2	4	4	4	4	4
Next Generation Industrial Hydraulic and Lube Fluids	4	2	2	2	4	4	4	4	5	5	5
Heat Transfer Design and New Fluids	1	1	1	1	1	2	2	2	2	2	2
Processes - Encapsulants, Dye Carriers											
New Bi/Tri/Quaterphenyl Derivatives	2	2	2	3	3	3	6	6	7	7	7
Wet Strength/Retention Aid	4	1	2	3	3	3	4	4	4	4	4
Total Expansion	14	9	11	13	16	17	24	24	26	26	26

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TECHNICAL PROGRAM Business Group: Specialty Products (Cont'd.)	MAN-YEARS PER YEAR										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Regenerative											
Skydraul/Coolanol Improvement	2	2	2	2	2	2	2	2	2	2	2
Dielectric Product Improvement	3	3	2	3	3	3	3	3	2	2	2
Industrial Hydraulics and Lubes	3	3	2	2	2	2	3	3	3	3	3
Heat Transfer Design and Improved Products	1	1	1	1	1	1	2	2	2	2	2
Plasticizer Terphenyl Derivatives and Replacements	-	-	1	2	2	2	3	3	3	3	3
Rosin Size Improvement	3	2	2	2	2	2	2	2	2	2	2
New Wet End Sizing Systems	1	-	4	4	4	4	4	4	4	4	4
Scripsets Modification and Replacements	5	1	2	2	3	3	3	3	3	4	4
Pentachlorophenol Quality Process, Replacements	-	-	1	1	1	1	-	-	-	-	-
Total Regenerative	18	12	17	19	20	20	22	22	21	22	22
Supporting											
Customer Technical Service	5	5	5	5	6	6	7	7	8	8	9
Manufacturing Support	4	4	4	4	4	5	6	6	7	7	7
Wood Treating Chemical Co. Support	4	-	-	-	-	-	-	-	-	-	-
Management and Clerical	4	2	2	3	3	3	3	3	3	3	3
- Total Supporting	17	11	11	12	13	14	16	16	18	18	19
TOTAL SPECIALTY PRODUCTS	65	44	60	69	75	72	84	84	88	90	92