PROGRESS REPORT

PROCESS ENGINEERING DEPARTMENT

ORGANIC CHEMICALS DIVISION

JOB NUMBER: OPEA 1430 P.S.

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** To Receive Details Section*

TITLE: AROCLOR QUALITY IMPROVEMENT

PERSONNEL: D. A. Snyder (L. L. Fellinger)

PROBLEM:

1. Summarize project background.
2. Determine capital requirements for expansion and upgrading of WGK Aroclor facilities.
3. Present recommendation for future action.

SUMMARY: New specifications for electrical grade Aroclor were proposed at the divisional Aroclor meeting of March 10, 1966. WGK PR & D has proposed that KOH washing and fractional distillation be added to the existing process to meet the revised specifications. This proposal could also apply to the Anniston Aroclor plant. Capital requirements for this proposal were determined as follows:

Straight Takeover Distillation	250,000
Additional capital for fractionation	125,000
KOH washing of crude	170,000
Earth treatment	295,000
Tank farm	400,000
	1,240,000

These figures are for a 50M lb/yr Aroclor plant. No capital is provided for changes in the chlorination area. Both engineering and contingencies are included as 15% of installed equipment cost.

Definition of the process proposal is not complete enough for preparation of a detailed engineering scope. Organic Process Engineering will continue to follow plant quality efforts in anticipation of future expansion.

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DETAILS:

General Background

Chlorinated biphenyl (Aroclor) has long been a successful product for Monsanto. Monsanto Company is the sole Aroclor producer in the United States. Current annual sales are approximately 64M lbs. Monsanto Chemicals Ltd. produces 7M lbs. annually and is well established in the United Kingdom. Monsanto accounts for about 75% of the world Aroclor market. The remainder is shared by five other producers.

Quality

Maintenance of product quality is necessary to protect Monsanto's enviable marketing position. About half of Monsanto's production is used as a dielectric fluid in transformers and capacitors. This material must pass rigid specifications. Important quality considerations for electrical grade material are resistivity, power factor, water content, and stability. In each of these catagories Monsanto Aroclor compares poorly with that produced by foreign manufacturers, notably Prodelac (France) and Bayer (Germany).

Monsanto is having difficulty competing with the electrical grade foreign material in non-domestic markets. Monsanto's American customers are either unaware of the quality comparison or are unwilling to change from an established supplier. Whatever the reasons are, there appears to be an as yet unrecognized incentive for other companies to get into the American Aroclor business.

Revised electrical-grade specifications were established at the March divisional Aroclor meeting to meet the challenge of foreign competition and to protect existing markets. These quality goals call for material equal to or better (for resistivity, power factor, and stability) than that produced by the present competition.

Capacity

The standard capacity of the WGK Aroclor plant (Dept. 246) is 28.8M lb/yr. Anniston's standard capacity is 48M lb/yr. The potential capacity of Dept. 246 with existing equipment has been determined to be 36M lb/yr. Potential capacity at Anniston is now being determined.

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The sales forecast, Fig. 1, indicates that WGK will be out of capacity in 1967. If the existing potential is used, the "pinch" won't occur until 1969. In this event some of the WGK sales could probably be shifted to Anniston since it is predicted that they will have approximately 5M lb. or more excess proven capacity in 1969. However, in the 1970's maximum total production capacity of both locations will be realized.

Also, as part of the strategy adopted at the divisional Aroclor meeting, it was proposed that Monsanto should maintain a production capability at least 25% higher than annual sales. This relationship existed in 1965 but obviously cannot continue to be satisfied with the present production facilities.

Process Proposals

Plant personnel at both Anniston and WGK proceeded to determine methods of attaining the new quality goals at the conclusion of the divisional Aroclor meeting. Anniston has devoted most of its efforts to improving the earth treating area of the existing process. WGK has been studying the possibilities of KOH treatment of crude Aroclor followed by batch fractionation.

Evaluation of Process Revision

Flowsheets and equipment lists were prepared for the process revision proposed by WGK (WGK PR & D Report No. K177, 7-16-66). A capacity of 50M lb/yr. was chosen as a design basis. This would satisfy the 25% excess criteria until 1970. Excess capacity would be completely used by mid-1970's. If engineering were started now, start-up for a new facility would be early 1968.

Equipment requirements were determined for all process areas except biphenyl storage and the chlorinators. Additional biphenyl storage is to be included in a project scope for WGK storage facilities being prepared by ODPED. Sufficient capacity from the present chlorinators can most likely be obtained by increasing the chlorine supply and removing the catalyst baskets.

KOH treatment tank, still feed tank, stillpot, column, receivers and earth treating facilities were sized by assuming an 8 hr. batch time cycle. An addition of 165,000 gal. of storage was determined by requirements for a minimum product inventory.

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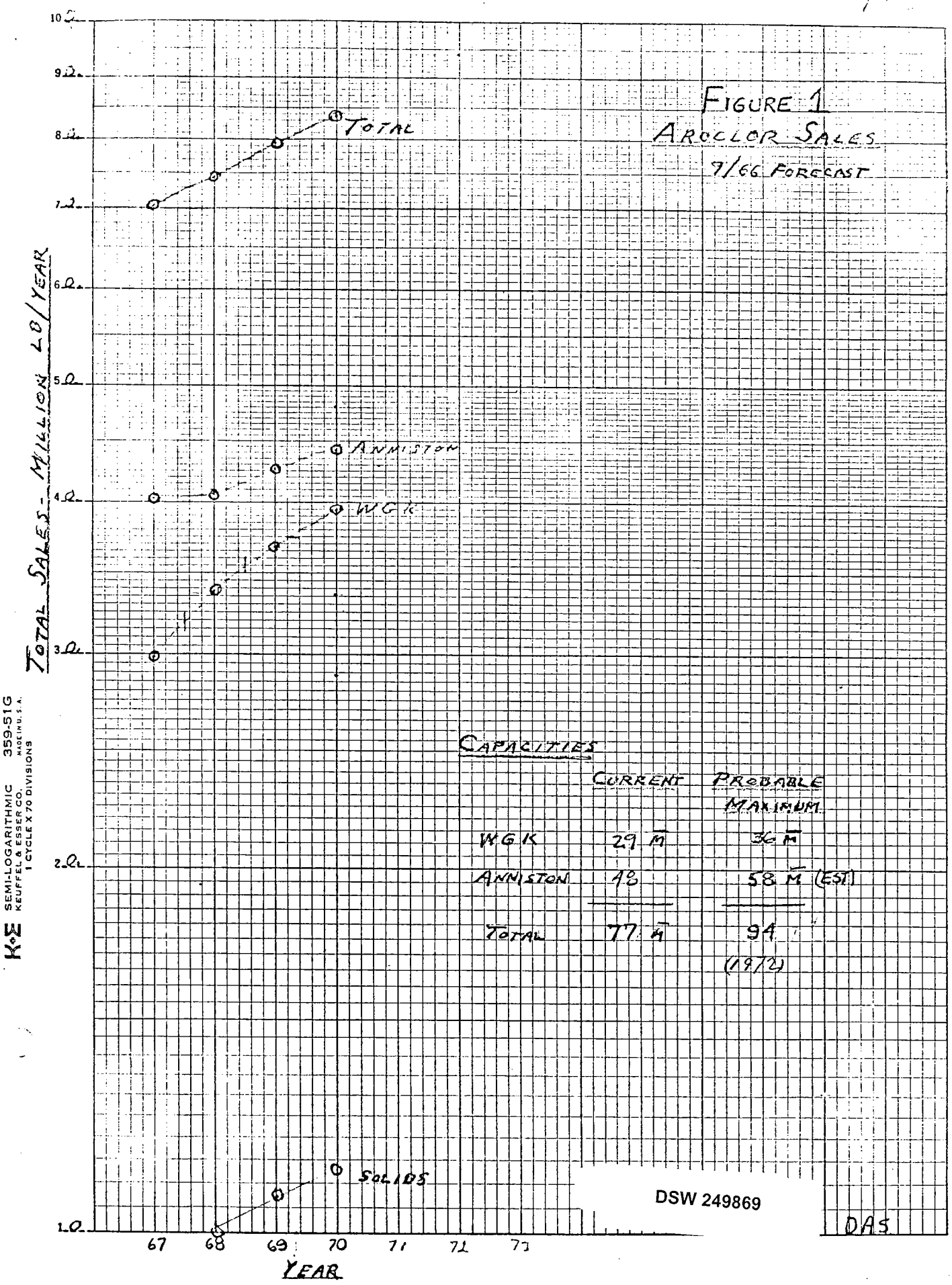
FIGURE 1
AROCLOR SALES
7/66 FORECAST



CAPACITIES

	CURRENT	PROBABLE MAXIMUM
WGK	29 M	36 M
ANNISTON	48	58 M (EST)
TOTAL	77 M	94 (1972)

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DAS

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Total project cost was determined by CED to be 1-1/4$\overline{M}$ dollars (CE Estimate No. 03-053). This was estimated by developing equipment costs and factoring by various catagories of equipment. Engineering and contingencies were each estimated at 15% of installed equipment cost.

Capital cost of various process areas were determined as follows:

Single Stage Batch Distillation	$ 250,000
Additional Capital for Fractionation	125,000
KOH Washing of Crude	170,000
New Earth Treatment Facilities	295,000
Tank Farm 165,000 Gal.	400,000
Total Project NFC	$1,240,000

This estimate can be extended to capacities other than 50$\overline{M}$ lb/yr. by multiplying by capacity ratio taken to .6 power.

Future Work

Research Work

Several important aspects must be considered before KOH treatment is added to the Aroclor process:

1. Explosion hazard - can there be an absolute guarantee that KOH will not build up to explosive levels in the stillpot?

2. Capital requirements - the KOH treatment tank must be nickel. CED estimates that $170,000 capital (for 50$\overline{M}$ lb/yr) is required for adding KOH treatment to process. Does the incremental improvement of stabilities justify this investment? Also, what is the risk for the investment when the statistical scatter of analysis is considered?

The advantages of fractionating crude Aroclor to obtain product quality are obvious. However, there are several unknowns that could offset the quality improvement:

1. Disposition of fore and tail cuts How will the various cuts for each aroclor be used? To what extent will blending be required? This will determine the overall yield and the capital required for storage and blending facilities.

2. Increased complexity of operation Day to day operation could become unwieldy. The five liquid Aroclors being made at

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WGK will each have a tailcut and forecut. The possible combinations of what to do with all of the cuts are numerous. Production planning would be tedious unless some simplified procedure can be found.

Plant Work

Plant TSD and research groups are working on areas that show much promise for quality and capacity improvement in the existing process:

1. Earth treatment - Anniston has demonstrated that Porocel earth and fixed-bed treatment can improve both resistivity and thermochemical stabilities. Results from both plant and laboratory tests have been encouraging.

2. Piping - Both Anniston and WGK are planning to minimize iron contamination by changing from steel to aluminum piping.

3. Nitrogen blanketing - Anniston is preparing a scope for this work. WGK already has nitrogen blanketing.

4. Process fundamentals - The effect of process variables upon quality is not well defined. Such work is essential to establish a firm design basis for new facilities. Anniston has a long-range plan that outlines such a study.

5. Debottlenecking - Ultimate capacity of present WGK facility has been determined. Anniston is working on determining their capacity.

Recommendations

Preparation of an engineering scope for the proposal of KOH washing and fractionation is at this time premature. However, Organic Process Engineering will follow plant and research efforts closely in anticipation of a management decision on new facilities.

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