

GAW
C&P R&D DIVISION
EXECUTIVE COMMITTEE REVIEW
JULY 31, 1981

THE MISSION OF THE C&P DEPARTMENT IS TO GENERATE CASH. OVER THE PERIOD 1981 THROUGH 1986 WE ARE COMMITTED TO GENERATE A NET CASH FLOW OF SOME \$350MM. ADDITIONALLY, WE HAVE A MAJOR ROLE TO SUPPLY CHEMICAL INTERMEDIATES TO OTHER DU PONT DEPARTMENTS AT COSTS EQUAL TO OR LOWER THAN COMPETITION.

THE SUCCESS OF THE RESEARCH AND DEVELOPMENT DIVISION IN CARRYING OUT ITS RESPONSIBILITIES IS A KEY ELEMENT IN ACHIEVING THE DEPARTMENT'S MISSION. IN MY REVIEW TODAY, I WILL ILLUSTRATE FOR YOU SOME OF THE PROGRAMS WE HAVE UNDERWAY TO ENSURE THIS SUCCESS.

~~THE AGENDA I WILL FOLLOW IS AS SHOWN.~~

EASEL

IN THE FIRST PART OF MY REVIEW, I WILL DISCUSS THE BUDGET AND FORECAST IN TERMS OF THE VARIOUS FUNCTIONS MANAGED WITHIN THE C&P RESEARCH AND DEVELOPMENT DIVISION. AS PART OF THIS DISCUSSION, I WILL ILLUSTRATE SOME PRODUCTIVITY IMPROVEMENT APPROACHES WE ARE IMPLEMENTING IN SUCH AREAS AS MANUFACTURING ASSISTANCE WORK, AND CONTROL LABORATORY AND PROJECT ENGINEERING STAFFING.

FOR THE MAJOR PART OF MY REVIEW, I WILL FOCUS ON OUR IEBC PROGRAMS. I WILL FIRST COMMENT ON OUR EFFORT DISTRIBUTION IN THE IMPORTANT AREAS OF COST REDUCTION, CAPACITY INCREASES, NEW PRODUCT DEVELOPMENT AND REGULATORY COMPLIANCE. THEN I WILL CITE SOME SPECIFIC STRATEGIC PROGRAMS THAT ILLUSTRATE

SOME OF THE CHALLENGES WE HAVE IN C&P^{AND} THAT I BELIEVE WILL SHOW YOU WE ARE RESPONDING TO THESE CHALLENGES IN AN INNOVATIVE, COST-EFFECTIVE MANNER.

SLIDE 1
LEFT

^{L (R)}
● FIRST, THE BUDGET. AS CAN BE SEEN ON THE SLIDE, THE RESEARCH AND DEVELOPMENT DIVISION IN C&P IS RESPONSIBLE FOR A NUMBER OF FUNCTIONS. OUR TOTAL 1981 EXPENDITURE IS ESTIMATED AT \$97.6MM, GROWING TO SOMETHING IN EXCESS OF \$136MM BY 1986. MANPOWER WILL BE REDUCED SIGNIFICANTLY OVER THE PERIOD. LET ME COMMENT ON EACH FUNCTION.

SLIDE 2
LEFT

^L
● IN 1981, THE TOTAL IMPROVEMENT TO ESTABLISHED BUSINESS BUDGET IS 1.7% OF SALES AND IN 1986 IT WILL BE ABOUT 1% OF SALES. MANPOWER WILL DECLINE FROM 201 TO 182 OVER THE PERIOD. WE BELIEVE THIS MANPOWER REDUCTION IS CONSISTENT WITH OUR TOTAL MISSION AND PROVIDES THE PROPER LEVEL OF SUPPORT TO THE DEPARTMENTS' BUSINESSES. I WILL HAVE MORE TO SAY ON OUR EFFORT DISTRIBUTION LATER.

SLIDE
3-LEFT

^L
● OUR TECHNICAL ASSISTANCE TO MANUFACTURING MANPOWER WILL ALSO DECREASE OVER THE PERIOD. THIS WILL OCCUR BECAUSE WE WILL COMPLETE MANY OF THE COST REDUCTION AND MAJOR REGULATORY ACTIVITIES WE UNDERTOOK SEVERAL YEARS AGO AND FROM IMPROVEMENTS IN PRODUCTIVITY.

SLIDE
3-RIGHT

^R
● PRODUCTIVITY IMPROVEMENT, THAT IS THE NEED FOR FEWER PEOPLE, IS AN ONGOING EFFORT IN C&P. AS WE EXIT CERTAIN UNPROFITABLE BUSINESSES, WE CUT OUR MANPOWER, OF COURSE.

MANPOWER REDUCTIONS ARE ALSO A DIRECT BY-PRODUCT OF SEVERAL ONGOING TECHNICAL PROGRAMS. THESE INCLUDE OUR WORK IN COLORED PIGMENTS AND TITANIUM DIOXIDE TO REDUCE THE TOTAL NUMBER OF PRODUCTS BY SUBSTITUTING SINGLE MULTI-PURPOSE PRODUCTS, THUS SIMPLYING THE MANUFACTURING TASK, AS WELL AS OUR BROAD EFFORT TO INSTALL MODERN COMPUTER MONITORING AND CONTROL IN MANY OF OUR PROCESSES TO IMPROVE PROCESS EFFICIENCY AND PRODUCT QUALITY, AND BY OUR PRODUCTION DIVISION'S EFFORTS TO IMPROVE PROCESS RELIABILITY.

IN TOTAL THESE PROGRAMS WILL ALLOW US TO REDUCE THE ASSISTANCE TO MANUFACTURING MANPOWER BY ABOUT 1% YEARLY THROUGH THE FORECAST PERIOD. L (L) (R)

SLIDES
OFF

LET'S TURN NOW TO THE WORK WE CARRY OUT FOR OTHER DEPARTMENTS.

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SLIDES
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L IN VIRTUALLY ALL OF THIS EFFORT, OUR PRIMARY FOCUS IS ON COST REDUCTION. WE HAVE PROGRAMS UNDERWAY FOR METHYL METHACRYLATE AND ACRYLONITRILE AT MEMPHIS THAT WILL IMPROVE CUMULATIVE 1981 THROUGH 1986 EARNINGS BY \$30MM AND \$40MM, RESPECTIVELY. IN ADDITION, AT CHAMBERS WORKS AND REPAUNO WE MAKE THE KEY INTERMEDIATES, OXYDIANILINE AND PYROMELLITIC DIANHYDRIDE, USED TO MANUFACTURE KAPTON®. HERE OUR PRINCIPAL OBJECTIVES ARE TO ENSURE SUPPLY AND QUALITY TO SUPPORT THE GROWTH OF THIS BUSINESS AND TO HAVE COSTS LOWER THAN EMERGING

COMPETITION. IN 1980, WE ACCOMPLISHED LOW-INVESTMENT EXPANSIONS FOR BOTH PRODUCTS AND IMPROVED YIELDS OF PYROMELLETIC DIANHYDRIDE, THE LATTER SAVING OVER \$700M/YEAR IN 1980 DOLLARS.

SLIDES 5
LEFT +
RIGHT

L R

● C&P R&D IS ALSO RESPONSIBLE FOR THE MANAGEMENT OF THE MAJORITY OF CONTROL LABORATORIES AND PROJECT ENGINEERING FACILITIES FOR THE DEPARTMENT. IN BOTH THESE FUNCTIONS WE SEE OPPORTUNITIES FOR PRODUCTIVITY IMPROVEMENT.

IN CONTROL LABORATORIES, WE EXPECT TO REDUCE TO A MINIMUM THE NUMBER OF PROFESSIONALLY TRAINED PERSONNEL REQUIRED, THUS FREEING THESE PEOPLE TO CONTRIBUTE THEIR TALENTS TO MORE DEMANDING TASKS. THIS WILL BE DONE THROUGH ESTABLISHMENT OF WELL-DOCUMENTED ROUTINE TESTS, MORE USE OF AUTOMATED ANALYTICAL EQUIPMENT, AND TRAINING OF NON-PROFESSIONALS TO OPERATE AND SERVICE THE ANALYTICAL EQUIPMENT. WE ARE CURRENTLY DEVELOPING THIS APPROACH AT EAST CHICAGO AND CLEVELAND, AND TO DATE HAVE REDUCED EXEMPT PERSONNEL BY 15% AND EXPECT THIS TO INCREASE TO 30% IN THE NEAR FUTURE. THESE REDUCTIONS WILL BE MADE WITHOUT INCURRING RISK TO PRODUCT QUALITY OR PRODUCTION INTEGRITY.

L R

SLIDES 6
LEFT +
RIGHT

● IN PROJECT ENGINEERING, WE EXPECT TO UTILIZE MORE FULLY PRIVATE OUTSIDE CONTRACTORS TO TAKE PEAK LOADS. WE WILL ALSO UTILIZE OUR ENGINEERING DEPARTMENT'S SMALL PROJECTS GROUP TO DO MORE OF THE WORK AT THE PLANT SITES, AND FINALLY, WE ARE SEEKING OPPORTUNITIES TO CONSOLIDATE AMONG PLANTS. WE HAVE ALREADY DONE THIS AT OUR NEWARK AND

GRASSELLI, NJ PLANTS. WE HAVE PLACED ALL PROJECT PERSONNEL AT GRASSELLI, WITH THE EXCEPTION OF ONE COORDINATOR AT NEWARK, AND HAVE OBTAINED A NET MANPOWER REDUCTION OF FOUR.

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SLIDES
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● OUR PATENTS AND LICENSING GROUP IN C&P HAS RESPONSIBILITY FOR LIAISON WITH THE PATENT DIVISION OF THE LEGAL DEPARTMENT.

LAST YEAR

WE FILED 58 U.S. PATENTS AND WERE GRANTED 37. THIS YEAR WE EXPECT TO BE AT A SIMILAR LEVEL. WE ARE ALSO THE PRINCIPAL NEGOTIATOR FOR THE DEPARTMENT UNDER THE GUIDANCE OF PRODUCT DIVISION MANAGEMENT AND GENERAL MANAGEMENT FOR ALL TECHNOLOGY LICENSING AND SALE. ACTIVITIES THIS YEAR INCLUDED THE NEGOTIATION WITH DEGUSSA FOR EXTENSION OF THE PEROXIDE TECHNOLOGY LICENSE TO CANADA, SALE OF RESIDUAL PARTS OF THE DYES BUSINESS, ^{AND} LICENSING THE KIKUCHI COMPANY IN JAPAN UNDER OUR LEAD CHROMATE PATENT,

OUR PRETAX INCOME FROM

LICENSING ACTIVITY AMOUNTED TO \$5.5MM IN 1980 AND IS EXPECTED TO CONTINUE AT A \$3-5MM/YEAR LEVEL FOR THE FORESEEABLE FUTURE.

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SLIDES
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RIGHT

● OUR PLANNING AND INTELLIGENCE GROUP'S PRINCIPAL ACTIVITIES ARE THE PRODUCTION OF DOCUMENTED REPORTS AND INVESTIGATIONS TO ASSIST R&D AND THE PRODUCT DIVISIONS TO OBTAIN CLEAR DEFINITIONS OF COMPETITIVE TECHNOLOGY POSITION. ACTIVE PROGRAMS IN THIS GROUP INCLUDE ASSESSMENT OF FUTURE FEEDSTOCKS OPTIONS FOR OUR METHANOL PLANTS AT DEER PARK AND BEAUMONT AND COMPETITIVE ANALYSES OF OUR TECHNOLOGICAL

POSITIONS IN SUCH BUSINESSES AS TiO_2 , COLORED PIGMENTS AND AROMATIC PRODUCTS. THIS GROUP LAST YEAR ALSO CARRIED OUT A MAJOR STUDY OF COMPETITIVE ECONOMICS OF ALTERNATIVE PROCESSES FOR TETRAHYDROFURAN. I WILL HAVE MORE TO SAY ON TETRAHYDROFURAN SHORTLY.

SLIDE
1 LEFT

L (R)
● FINALLY, IT IS THE RESPONSIBILITY OF THE R&D DIVISION TO BE THE PRINCIPAL RECRUITING ARM FOR THE DEPARTMENT. THIS YEAR R&D EXPECTS TO HIRE 64 PROFESSIONALS, ALMOST EXCLUSIVELY ENGINEERS. DEPARTMENTALLY WE EXPECT TO HIRE 78, THE DIFFERENCE BEING SOME SPECIALIZED ACCOUNTING AND MARKETING PERSONNEL. WE ARE NOW ESSENTIALLY COMPLETE AND HAVE HAD AN EXCELLENT HIRING YEAR WITH HIGH-QUALITY PEOPLE OBTAINED. OUR AFFIRMATIVE ACTION GOALS WERE EXCEEDED WITH 65% FEMALES AND OTHER MINORITIES HIRED. DESPITE THIS INFLUX, WE EXPECT TO REDUCE OUR TOTAL R&D MANPOWER IN 1982 FROM THE PRESENT 689 TO 667. THIS MEANS THAT IN ADDITION TO RETIREMENTS WE HAVE A VERY ACTIVE PROGRAM TO TRANSFER PERSONNEL TO OTHER DIVISIONS. TO PREPARE FOR THESE TRANSFERS WE ADMINISTER AN EXTENSIVE TRAINING PROGRAM FOR BOTH OUR YOUNG AND OUR MATURE PROFESSIONALS.

SLIDE
10 LEFT

● LET'S TURN NOW TO OUR IEB RESEARCH EFFORT. THIS SLIDE SHOWS THE EFFORT DISTRIBUTION FOR 1981 AND COMPARES IT WITH RECENT HISTORY. BEYOND 1981 WE EXPECT COST REDUCTION WILL CONTINUE TO BE A HIGH PERCENTAGE OF OUR EFFORT.

SLIDES
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RIGHT

L R
● COST REDUCTIONS THROUGH YIELD IMPROVEMENT AND REDUCED

ENERGY CONSUMPTION ARE LARGE AND LUCRATIVE OPPORTUNITIES FOR THE C&P DEPARTMENT. IN 1980, WE ACCOMPLISHED \$22MM, WE EXPECT \$42MM IN 1981 AND OUR CUMULATIVE TOTAL FOR THE FIVE YEAR PERIOD IS EXPECTED TO BE OVER \$500MM IN SAVINGS. WE ARE HEAVILY ENERGY REDUCTION ORIENTED IN OUR PROGRAMS, WITH PROGRAMS UNDERWAY OR IDENTIFIED THAT WILL ENSURE WE MEET THE DEPARTMENT'S 1985 GOAL.

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SLIDES
12
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PRODUCT IMPROVEMENT WORK IS PRIMARILY IN SPECIALTY CHEMICALS WITH A SMALL AMOUNT OF EFFORT IN COLORED PIGMENTS. IN SPECIALTY CHEMICALS, WE ARE DEVELOPING NEW AND IMPROVED ANTI-SOIL FLUORO-CHEMICALS FOR DIRECT THREADLINE APPLICATION TO CARPET FIBERS IN SUPPORT OF TEXTILE FIBERS DEPARTMENT AND OUR MERCHANT BUSINESS. THIS NEW MARKET, WHICH IS FORECAST TO GROW VIGOROUSLY FOR THE NEXT SEVERAL YEARS, HAD \$5MM SALES AND TRANSFERS IN 1980 AND IS EXPECTED TO REACH \$17MM THIS YEAR. IN COLORED PIGMENTS, WE ARE

DEVELOPING NEW PRODUCTS TO MEET CHANGING CUSTOMER NEEDS. FOR EXAMPLE, BOTH FABRICS & FINISHES AND OUR OTHER CUSTOMERS NEED PIGMENTS SUITABLE FOR THE HIGH-SOLIDS, LOW-SOLVENT CONTAINING ENAMELS. THESE ARE CURRENTLY BEING TURNED TO BY THE AUTOMOTIVE INDUSTRY TO MEET FOREIGN COMPETITION AND TO COMPLY WITH EPA REGULATIONS. WE ARE ALSO FIELD TESTING A NEW GOLD COLORED PIGMENT FOR AUTOMOTIVE PAINT AND PLASTIC APPLICATIONS WHICH IS BASED ON TECHNOLOGY STEMMING FROM OUR PROFITABLE QUINACRIDONE PRODUCTS. THIS PRODUCT, WHICH IS PROPRIETARY, HAS EXCITED THE STYLISTS AT

FORD AND GENERAL MOTORS AND BOTH ARE PLANNING TO USE IT STARTING IN THE 1984 MODEL YEAR.

SLIDES
13
LEFT +
RIGHT

L R
● OUR EFFORT TO INCREASE CAPACITY IS PRIMARILY IN TERACOL® WITH OUR RECENTLY COMPLETED EXPANSION OF THE NIAGARA FALLS PLANT, AND THE \$29MM DORDRECHT NETHERLANDS FACILITY NOW UNDER CONSTRUCTION. WE ARE ALSO EXPANDING CAPACITY AT CHAMBERS WORKS FOR OUR HIGHLY PROFITABLE TYZOR® ORGANIC TITANATES TO MEET THE RAPIDLY GROWING DEMAND FOR THESE MATERIALS IN SECONDARY OIL AND GAS RECOVERY.

EARLIER THIS YEAR WE COMPLETED A SMOOTH STARTUP OF THE NEW PHTHALOYL CHLORIDES PLANT AT CHAMBERS WORKS. THIS \$33MM INVESTMENT GIVES US A LONG-TERM, LOW-COST POSITION FOR ONE OF THE TWO PRINCIPAL KEVLAR® INTERMEDIATES AND PROVIDES US A STRONG POSITION ON WHICH TO COMPETE IN THE EMERGING MERCHANT MARKET WHERE PHTHALOYL CHLORIDES ARE USED IN NEW ENGINEERING PLASTICS.

SLIDE
14 LEFT

L (R)
● FINALLY, WHILE OUR REGULATORY EFFORT IS A RELATIVELY SMALL PROPORTION OF OUR TOTAL BUDGET, IT IS OF SIGNIFICANT IMPORTANCE TO SEVERAL BUSINESSES, IN PARTICULAR ANILINE AND TITANIUM DIOXIDE. I WILL HAVE MORE TO SAY ON BOTH OF THESE SHORTLY. THIS COMPLETES MY COMMENTS ON EFFORT DISTRIBUTION. (L)
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SLIDE
14 OFF

NOW I WILL HIGHLIGHT THREE OF OUR MAJOR IEB PROGRAMS .

LET'S START WITH ANILINE. ANILINE IS A COMMODITY CHEMICAL WITH 60% OF CURRENT SALES GOING FOR USE IN ISOCYANATES. THESE ISOCYANATES ARE USED IN SUCH HIGH-VOLUME APPLICATIONS AS RUBBER CURING CHEMICALS AND IN POLYURETHANES FOR MANUFACTURE OF ADHESIVES AND RIGID AND FLEXIBLE FOAMS. WE HAVE TWO PLANTS - AS SHOWN.

SLIDE
15 LEFT

OUR BEAUMONT PLANT IS THE LARGEST IN THE UNITED STATES. OUR TOTAL CAPACITY IS 42% OF DOMESTIC CAPACITY. ANILINE HAS BEEN A GOOD BUSINESS FOR US AND IN 1980 GENERATED \$17MM IN PRETAX EARNINGS. HOWEVER, TO REMAIN COMPETITIVE AFTER OUR FAVORABLE GAS CONTRACT EXPIRES IN 1985, WE MUST MEET A TIGHT TIMETABLE TO REDUCE THE ENERGY REQUIRED TO MANUFACTURE ANILINE AND TO TREAT ITS WASTE STREAMS.

SLIDE
16 LEFT

ANILINE IS PRODUCED BY NITRATING BENZENE TO NITROBENZENE WITH A MIXTURE OF CONCENTRATED NITRIC AND SULFURIC ACIDS, FOLLOWED BY LIQUID PHASE CATALYTIC REDUCTION WITH HYDROGEN. WATER, A BY-PRODUCT IN THE NITRATION REACTION, DILUTES THE SULFURIC ACID AND MUST BE REMOVED BY CONCENTRATION. IN 1980, SULFURIC ACID CONCENTRATION COSTS WERE \$4.8MM AND THESE CONCENTRATION COSTS ARE FORECAST TO BE OVER \$13MM IN 1985.

SEVERAL YEARS AGO WE RECOGNIZED THAT THE HEAT OF NITRATION, WHICH IS NORMALLY REMOVED BY COOLING THE REACTOR, COULD BE USED TO PROVIDE ENOUGH ENERGY TO VAPORIZE THE WATER FORMED.

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SLIDE 17 LEFT L ● BASED ON THIS IDEA WE HAVE DESIGNED A PROCESS IN WHICH

'NITROGEN IS
BLOWN THROUGH THE NITRATORS, BECOMES SATURATED WITH WATER AND
THEN THE WATER IS CONDENSED AND THE NITROGEN RECYCLED FOR
REPEATED USE. NITROBENZENE IS SIMPLY DRAWN OFF, SEPARATED
FROM THE SULFURIC ACID AND THE SULFURIC ACID RECYCLED.

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SLIDE 17 RIGHT L ● WE CALL THIS PROCESS DEHYDRATING NITRATION AND IT IS
PROPRIETARY TO DU PONT. AS SHOWN ON THE RIGHT-HAND SLIDE,
THIS REDUCES THE ENERGY TO REMOVE WATER BY NEARLY 78%.
COMPARED WITH OUR CONVENTIONAL PROCESS AT BEAUMONT, AND
PLACES US IN A VERY FAVORABLE POSITION OPPOSITE COMPETITION.

LABORATORY WORK IS COMPLETE AND WE ARE NOW WORKING IN A JOINT
EFFORT WITH THE ENGINEERING DEPARTMENT TO MODIFY A REPAUNO
COMMERCIAL REACTOR TO GIVE US A ONE-TENTH SCALE DEMONSTRATION
UNIT. WE EXPECT TO HAVE THIS UNIT OPERATING BY SECOND QUARTER
1982 AND WILL INSTALL DEHYDRATING NITRATION AT BEAUMONT BY
LATE 1984.

THIS PROCESS WILL ALLOW US TO ELIMINATE THE SULFURIC ACID
CONCENTRATORS FOR A SAVINGS OF \$8MM/YEAR BY 1985. WITH THIS,
AND PROGRAMS AIMED AT EFFLUENT REDUCTIONS AND YIELD

IMPROVEMENTS, WE EXPECT TOTAL COST REDUCTION IN 1985 TO BE IN EXCESS OF \$15MM ANNUALLY TO MAKE OUR ANILINE PLANT AT BEAUMONT FULLY COMPETITIVE THROUGH THE 1980'S. WE ALSO HAVE PLANS TO IMPROVE THE ECONOMICS OF OUR SMALLER PLANT AT REPAUNO. THESE PRIMARILY INVOLVE INCREASING MERCHANT SALES TO GAIN CAPACITY UTILIZATION, SHARING THE FACILITIES WITH TOLUIDINE MANUFACTURE AND SALE OF THE DILUTE SULFURIC ACID FOR METAL TREATMENT. (L)(R)

SLIDES
7 OFF

LET'S TURN NOW TO TITANIUM DIOXIDE, WHICH IS FORECAST TO BE THE SINGLE LARGEST CASH GENERATOR IN THE THE DEPARTMENT. OVER THE NEXT FIVE YEARS,

THIS BUSINESS IS EXPECTED TO YIELD \$129MM IN NET CASH FLOW.

SLIDE
13 LEFT

THIS RESULTS FROM OUR EXTREMELY STRONG MANUFACTURING POSITION WITH PLANTS AS SHOWN, AND OUR STRONG MARKET POSITION IN THE U.S. REFLECTED IN OUR 40% MARKET SHARE. ALL OUR PLANTS ARE BASED ON THE EFFICIENT CHLORIDE PROCESS. OUR MAJOR COMPETITORS, SCM AND KERR MCGEE, UTILIZE THE CHLORIDE PROCESS BUT USE EXPENSIVE HIGH-GRADE ORE WHILE NATIONAL LEAD USES THE SULFATE PROCESS, WHICH IS LESS ENERGY EFFICIENT AND REQUIRES COSTLY WASTE DISPOSAL.

THE MAIN THRUSTS OF OUR RESEARCH ARE AIMED AT COST REDUCTION AND ALTERNATIVE ROUTES FOR DISPOSAL OF OUR IRON CHLORIDE WASTES. (L)

SLIDE
18 OFF

FIRST LET ME TALK ABOUT COST REDUCTIONS WHERE OUR TOTAL COMMITMENT IS TO REDUCE COSTS 2.4%/YEAR OR ABOUT \$10MM/YEAR THROUGH THE FORECAST PERIOD. THE TOTAL INVESTMENT TO ACCOMPLISH THIS FIVE YEAR PROGRAM IS FORECAST TO BE IN THE RANGE OF \$20 TO \$25M

SLIDE
19 LEFT

● THE FIRST STEP IN THE CHLORIDE PROCESS FOR TITANIUM DIOXIDE MANUFACTURE INVOLVES REACTING ORE WITH CHLORINE

AND COKE AT HIGH TEMPERATURES. THIS PRODUCES GASEOUS TITANIUM TETRACHLORIDE ALONG WITH A MIXTURE OF FERROUS AND FERRIC CHLORIDE. THESE GASES AND ENTRAINED PARTICULATE COKE ARE TAKEN THROUGH A SEPARATION UNIT TO REMOVE THE IRON CHLORIDES AND THEN TO A PURIFICATION UNIT FOR THE TITANIUM TETRACHLORIDE.

SLIDE
19 RIGHT

● IN THIS CHLORINATION PROCESS ABOUT 25% OF THE CHARGED COKE IS BLOWN OUT OF THE REACTOR AND COLLECTED ALONG WITH THE IRON CHLORIDE WASTE. CURRENTLY, AFTER SEPARATING FROM THE IRON CHLORIDE, THIS IS LAND FILLED, A STEP WHICH INCURS ADDITIONAL EXPENSE. TOTAL COSTS ASSOCIATED WITH THIS LOSS IN 1981 WILL EXCEED \$5MM. WE ARE EXAMINING TWO LEADS

TO REDUCE THESE LOSSES. THE FIRST INVOLVES USE OF A HIGH TEMPERATURE SEPARATION CYCLONE PLACED BETWEEN THE REACTION FURNACE AND SPRAY CONDENSER TO COLLECT AND SEPARATE THE COKE FOR RECYCLE. HOWEVER, THIS APPROACH WILL REQUIRE SIGNIFICANT INVESTMENT, AND HAS DIFFICULT MAINTENANCE PROBLEMS BECAUSE OF THE HIGH TEMPERATURES AND CORROSIVE AND ABRASIVE CONDITIONS THAT MUST BE DEALT WITH. FOR THIS REASON WE HAVE SOUGHT ALTERNATIVES. THE MOST IMPORTANT INVOLVES

PREVENTION OF BLOWOVER IN THE FIRST PLACE BY KEEPING COKE EXCESS AS CLOSE AS POSSIBLE TO THE THEORETICAL MINIMUM. HOWEVER, THIS CREATES AN EXTREMELY DIFFICULT CHLORINATOR BED CONTROL PROBLEM. IF WE DROP BELOW THE CRITICAL COKE MASS EVEN FOR A FEW MINUTES, CHLORINE GAS WILL EXIT THE BED AND CREATE A SERIOUS CONTROL HAZARD. IN SEEKING APPROACHES TO MONITOR AND CONTROL THE COKE, ORE AND CHLORINE RATIOS CLOSER TO THE THEORETICAL, WE HAVE RECENTLY FOUND THAT OXYGEN AND CARBON MONOXIDE LEVELS APPEAR TO DO THIS. IN CONJUNCTION WITH THE ENGINEERING DEPARTMENT, WE ARE NOW TRYING TO DEVELOP INSTRUMENTATION THAT WILL RELIABLY SENSE THESE GASES ON AN INSTANTANEOUS BASIS IN THE CORROSIVE ATMOSPHERE OF CHLORINE AND ARE QUITE ENCOURAGED BY INITIAL RESULTS. WE EXPECT TO CHOOSE THE OPTIMUM APPROACH TO THIS OPPORTUNITY FOR COST REDUCTION BY YEAR-END.

L (R)

SLIDE
20 LEFT

● A SECOND MAJOR COST REDUCTION EFFORT FOR TiO_2 IS IN THE PIGMENT FORMING STEP OF THIS PROCESS. IN THIS STEP, SHOWN ON THE UPPER PART OF THE SLIDE, THE PURIFIED TITANIUM TETRACHLORIDE IS RE-OXIDIZED TO TITANIUM DIOXIDE IN A BURNER,

IN THIS EQUIPMENT, CRITICAL PROPERTIES SUCH AS PARTICLE SIZE, SIZE DISTRIBUTION AND CRYSTAL STRUCTURE ARE DETERMINED IN THE FIRST STAGE OF THE REACTOR TUBE FOLLOWING THE BURNER NOZZLE. THE FORMED PARTICLES ARE THEN

R CAREFULLY COOLED IN STAGES TO PREVENT EXTENSIVE AGGLOMERATION.

SLIDE
20 RIGHT

● NEVERTHELESS, AGGLOMERATION DOES OCCUR, AND THE PIGMENT MUST BE GROUND TO FINAL PARTICLE SIZE IN ENERGY INTENSIVE MILLS.

TO REDUCE THIS GRINDING ENERGY, WE HAVE DEVELOPED A TECHNIQUE TO GENERATE THE PRECISE PARTICLE SIZE NEEDED IN THE OXIDATION BURNER DIRECTLY. THIS IS DONE THROUGH THE USE OF A NOVEL REACTOR DESIGN, AS SHOWN AT THE BOTTOM OF THE SLIDE. HERE THE TUBE DIAMETER IS EXPANDED A SHORT BUT CRITICAL DISTANCE FROM THE BURNER. THIS LESSENS SECONDARY PARTICLE-PARTICLE FUSION BY REDUCING TURBULENCE AND INCREASING THE SPACE BETWEEN PARTICLES GIVING THEIR SURFACE TIME TO COOL AND HARDEN. THIS "MUFFLER FLUE", AS WE CALL IT, HAS ALREADY BEEN DEMONSTRATED AT NEW JOHNSONVILLE AND REDUCED GRINDING ENERGY BY 1100 BTU/LB. OR ABOUT 8% OF THE TOTAL ENERGY USED IN MANUFACTURE OF TiO_2 . WHEN EXTENDED TO DE LISLE, THIS TECHNIQUE WILL CONTRIBUTE OVER \$1.8MM ANNUAL SAVINGS STARTING IN 1983. JOINT PROGRAMS WERE CARRIED OUT WITH ENGINEERING DEPARTMENT TO DEVELOP THE COMPUTERIZED KINETIC MODEL THAT WAS THE BASIS FOR THIS DEVELOPMENT ● (L) (R)

IDES 20
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IGHT OFF

AS MY LAST SUBJECT ON TiO_2 , I'D LIKE TO COMMENT ON DEEP WELL DISPOSAL OF BY-PRODUCT WASTES - PRIMARILY IRON CHLORIDES.

WE BELIEVE THAT IT IS VITAL THAT WE BE PREPARED FOR ADVERSE ENVIRONMENTAL PULINGS AGAINST DEEP WELLS. THE DISPOSAL PROBLEM IS LARGE BY ANY MEASURE. AT DE LISLE AND JOHNSONVILLE, WE HAVE COMBINED CAPACITY TO MANUFACTURE OVER 300,000 TONS/YEAR OF BY-PRODUCT IRON CHLORIDE. AT ANTIOCH, WE USE A HIGH-GRADE ORE AND PAY A DISPOSAL COST FOR THE SMALL AMOUNT OF FERROUS CHLORIDE PRODUCED. AT EDGE MOOR WE HAVE

EQUINO MARKETS END SALE OF MOST OF OUR IRON CHLORIDE BY

CONVERTING IT TO SALES GRADE FERRIC CHLORIDE FOR USE IN WATER AND WASTE WATER TREATMENT. HOWEVER, WITH THE EDGE MOOR CAPACITY WE ESSENTIALLY SATURATE THE MARKETS THAT WE CAN COMPETITIVELY SERVE WITH THIS PRODUCT.

SLIDE
21 LEFT

WE HAVE CONSIDERED NUMEROUS ALTERNATIVES TO DEEP WELL DISPOSAL. PRINCIPAL ONES INCLUDED THE AVOIDANCE OF THE PROBLEM THROUGH THE USE OF HIGH-GRADE ORE. THIS IS IMPRACTICAL BECAUSE OF THE HEAVY INVESTMENT AT THE MINE SITE FOR IRON REMOVAL AND, IN ADDITION, CREATES A WASTE DISPOSAL PROBLEM. WE ALSO CONSIDERED THE CONVERSION OF FERRIC CHLORIDE INTO USEFUL ORGANIC PRODUCTS, FOR EXAMPLE, BY REACTION WITH METHANOL TO PRODUCE METHYL CHLORIDE AND PIGMENTARY IRON OXIDE. LAST YEAR WE FELT ENCOURAGED BY THIS APPROACH AND DISCUSSED IT WITH YOUR COMMITTEE. HOWEVER, FURTHER WORK ON THIS PROCESS SHOWED IT WAS ONLY EFFICIENT WITH FERRIC CHLORIDE AND NOT FERROUS CHLORIDE. SINCE MOST OF OUR WASTE IRON IS IN THE FERROUS FORM, FOR ECONOMIC USE OF ENERGY INTENSIVE CHLORINE, WE HAVE DECIDED TO PUT THIS APPROACH ASIDE. WE NOW BELIEVE, HOWEVER, THAT WE HAVE UNCOVERED AN APPROACH WHICH SEEMS TO HAVE THE ATTRIBUTES REQUIRED. WE CALL IT DRY NEUTRALIZATION. HERE THE MIXTURE OF SOLID FERRIC AND FERROUS CHLORIDES ARE COMBINED IN A SIMPLE MIXER WITH POWDERED LIME IMMEDIATELY AFTER SEPARATION FROM THE GASEOUS TITANIUM TETRACHLORIDE. AN EXOTHERMIC REACTION OCCURS TO FORM IRON OXIDES AND CALCIUM CHLORIDE AS A DRY POWDERED SOLID THAT WE BELIEVE QUALIFIES FOR DISPOSAL AT NONHAZARDOUS

SLIDES
22 LEFT
+ RIGHT

LAND FILL SITES. TRACE HEAVY METALS ARE CONVERTED TO THEIR INSOLUBLE OXIDES AS PART OF THE REACTION. OUR PROGRAM NOW IS TO VERIFY THAT THE PRODUCT IS SUITABLE FOR NONHAZARDOUS LAND FILL AND TO CARRY THE PROGRAM TO A FULL SCOPE DESCRIPTION, INCLUDING PILOT PLANT DEMONSTRATION OVER THE NEXT YEAR.

IT'S INTERESTING THAT EVEN WITH THIS APPARENTLY SIMPLE CHEMISTRY THERE WERE SOME SURPRISES. WE FOUND, FOR EXAMPLE, THAT TRACES OF WATER ARE NEEDED TO INITIATE THE REACTION. OTHERWISE IT GOES MUCH TOO SLOWLY FOR PRACTICAL CONSIDERATION. WE ALSO FOUND THAT A SIDE REACTION OF WATER AND AN INTERMEDIATE SPECIES GENERATES HYDROGEN GAS. THIS WAS DETECTED IN THE LABORATORY, WHERE WE WERE ABLE TO DETERMINE THE REACTION CONDITIONS TO AVOID THE HYDROGEN GENERATION AND PUT CONTROLS IN PLACE TO AVOID POTENTIAL SAFETY PROBLEMS DURING THE PRODUCTION OF TEST BATCHES OF NEUTRALIZED PRODUCT. [INSTALLATION OF A DRY NEUTRALIZATION PROCESS IN PLACE OF OUR DEEP WELLS WOULD REQUIRE SIGNIFICANT INVESTMENT AND OPERATING COST PENALTIES. WE WOULD ONLY EXPECT TO IMPLEMENT THIS PROGRAM IF REQUIRED BY REGULATIONS.]

LINES
22
IGHT +
EFT OFF

TO SUMMARIZE OUR TiO_2 PROGRAMS, WE ARE SUPPORTING THIS IMPORTANT BUSINESS STRONGLY BECAUSE OF ITS EARNINGS CAPABILITY AND TO REALIZE ITS POTENTIAL WE MUST MAINTAIN OUR SUPERIOR COST AND COMPETITIVE POSITION.

AS MY FINAL ILLUSTRATION OF C&P PROGRAMS, LET ME BRIEFLY DISCUSS OUR R&D PROGRAMS IN SUPPORT OF THE BUTANEDIOL/TETRAHYDROFURAN/TERACOL® FAMILY.

SLIDE
23 LEFT

L ● WE ARE THE ONLY DOMESTIC PRODUCER OF ALL THREE SEQUENTIAL PRODUCTS, ALTHOUGH BASF, GAF AND QUAKER HAVE VARIOUS LEVELS OF INTEGRATION AND COMPETE STRONGLY IN CERTAIN MARKET SEGMENTS. WE HAVE THE OVERALL TECHNOLOGY EDGE BUT COST FOR THF BASED ON ACETYLENE MAY BECOME NONCOMPETITIVE WITH ALTERNATE PROCESSES, BASED ON OTHER FEEDSTOCKS WHICH ARE FORECAST TO ESCALATE LESS RAPIDLY THAN ACETYLENE. THF IS MADE IN THE THREE STEPS PICTURED. AS SHOWN, THF IS CONVERTED TO TERACOL® BY ACID CATALYZED POLYMERIZATION. TERACOL® IS MANUFACTURED AND MARKETING IN A VARIETY OF MOLECULAR WEIGHTS. TERACOL® IS ALSO USED IN LYCRA®, ADIPRENE® AND HYTREL® AND THESE BUSINESSES CONTRIBUTED OVER \$94MM IN CORPORATE EARNINGS IN 1980.

SLIDE
24 LEFT

BECAUSE OF THE IMPORTANCE OF THESE BUSINESSES AND OUR CONCERN FOR ACETYLENE COSTS, WE HAVE BEEN GIVING MAJOR ATTENTION TO A POTENTIALLY LOWER COST ROUTE TO THF. FROM AN EXAMINATION OF NUMEROUS HYDROCARBON STARTING MATERIALS, AND THEIR DERIVATIVES, WE HAVE CONCLUDED THAT BUTADIENE HAS THE BEST POTENTIAL AS IS SHOWN GRAPHICALLY ON MY NEXT SLIDE. L ● L

ALTHOUGH BUTANE IS A LOWER COST FEEDSTOCK, PROCESS CONCEPTS TO UTILIZE IT HAVE TO DATE SHOWN LOW YIELDS AND HIGH INVESTMENT. WE HAVE, HOWEVER, WORK GOING ON IN CR&D DEPARTMENT TO IMPROVE YIELDS AND SEEK POTENTIAL FOR INVESTMENT REDUCTIONS THROUGH OXIDATION REACTOR IMPROVEMENTS.

IN THE MEANTIME WE ARE CONCENTRATING ON BUTADIENE WHERE IN THE LATTER HALF OF THE DECADE, IT IS EXPECTED TO BE A HIGH VOLUME BY-PRODUCT OF ETHYLENE STEAM CRACKING AND CONSEQUENTLY IS PROJECTED TO BE LOWER COST THAN MOST OTHER POSSIBLE FEEDSTOCKS WITH EVEN A LIKELIHOOD OF A DIP IN PRICE AS SHOWN.



L R

SLIDES
25 LEFT
+ RIGHT

● IN OUR PROCESS WHICH IS PROPRIETARY TO DU PONT, BUTADIENE IS REACTED WITH A COPPER CHLORIDE REDOX SYSTEM TO MAKE FURAN WHICH IS THEN HYDROGENATED TO TETRAHYDROFURAN. WE ARE NOW IN THE PILOT PLANT STAGE OF THIS PROCESS DEVELOPMENT. GOAL YIELDS AND REACTION RATES HAVE BEEN ACHIEVED. THE PRINCIPAL TECHNICAL DIFFICULTY WE FACE IS TO ACHIEVE PRACTICAL MASS TRANSFER RATES AS WE SCALE-UP REACTOR SIZE.

FORTUNATELY WE HAVE AN EXCELLENT MECHANISTIC UNDERSTANDING OF THE MANY PHYSICAL AND CHEMICAL REACTIONS INVOLVED FROM OUR OWN WORK AND WORK AT CR&D AND THE ENGINEERING DEPARTMENT. BASED ON THIS WE ARE QUITE OPTIMISTIC THAT WE WILL SOLVE THESE PROBLEMS. WE EXPECT TO HAVE THE ESSENTIAL PILOT PLANT DATA BY YEAR-END. OUR TOTAL ANTICIPATED INVESTMENT FOR THIS NEW PROCESS IS EXPECTED TO BE SUBSTANTIALLY BELOW THAT FOR A PROCESS BASED ON ANY OTHER ALTERNATIVE FEEDSTOCK. THIS PROCESS WILL GIVE US A SUPERIOR COST POSITION FOR TETRAHYDROFURAN AFTER 1990 VERSUS ANY COMPETITION REGARDLESS OF WHICH PRICE FORECAST BUTADIENE FOLLOWS.

DEPARTMENTALLY WE ARE NOW STUDYING THE STRATEGICALLY/ ADVANTAGEOUS TIME TO INSTALL A COMMERCIAL FACILITY BASED ON THIS TECHNOLOGY. THIS WILL PROBABLY BE AFTER THE MID-1980'S.



~~HALF OF THE DECADE.~~

L R

SLIDE
25 LEFT
+ RIGHT

L IN ADDITION TO THIS EFFORT, WE ARE EXPLORING A SIGNIFICANT
PRODUCT OPPORTUNITY CALLED TERACOL® TE.

THIS IS A COPOLYMER OF TETRAHYDROFURAN AND ETHYLENE
OXIDE AND IS MANUFACTURED IN A SIMPLER, LOWER INVESTMENT
PROCESS THAN TERACOL . TERACOL® TE IS ESTIMATED TO HAVE A
MILL COST ADVANTAGE OF AT LEAST 15% VERSUS TERACOL® EVEN
FROM A MODEST 20MM LB./YR. FACILITY. TEXTILE FIBERS LABORATORY
EVALUATION HAS SHOWN THAT LYCRA® FROM TERACOL® TE HAS GOOD
RETRACTIVE POWER AND ELONGATION. THEY BELIEVE THAT THESE
PROPERTIES AND ITS LOWER COST MAY LEAD TO DEVELOPMENT OF
NEW PRODUCTS. WHILE THESE WILL PROBABLY NOT BE AS GOOD
OVERALL AS THOSE MADE FROM TERACOL®, THERE DOES
APPEAR TO BE MARKET SEGMENTS THAT CAN USE THEM.
NON-FIBER USES IN NEW FAST CURING METAL ADHESIVES FOR
AUTO BODY ASSEMBLY ALSO APPEAR TO BE APPLICATIONS OF THIS
PRODUCT AND WE ARE WORKING WITH GOOD YEAR ON THIS.
OUR PRINCIPAL NEAR-TERM OBJECTIVE IS TO DEVELOP AN INTERIM
MANUFACTURING FACILITY THAT WILL SUPPLY ENOUGH MATERIAL TO
TEXTILE FIBERS THIS YEAR AND NEXT SO THAT COMMERCIALIZATION
PLANS CAN BE DEVELOPED. L ● (L) (R)

SLIDES
OFF

THIS COMPLETES MY REMARKS.

IN SUMMARY, WE ARE DETERMINED TO SUPPORT OUR
BUSINESSES IN A MANNER TO INSURE OUR PROCESSES
AND PRODUCTS ARE BROUGHT TO OR MAINTAINED AT THE DESIRED
COMPETITIVE LEVEL. WE RECOGNIZE THAT OUR PRINCIPAL EFFORT

MUST CONTINUE TO BE IN THE CRITICAL COST REDUCTION AREA AND WE APPROACH THIS TASK AS EXTREMELY CHALLENGING, REQUIRING THE BEST PROFESSIONAL AND INNOVATIVE EFFORTS.

TODAY I HAVE TOUCHED UPON ONLY A FEW PROGRAMS.

WE HAVE

SIMILAR PROCESS IMPROVEMENT CONCEPTS FOR VIRTUALLY ALL OF THE OTHER BUSINESSES AND WE FEEL VERY CONFIDENT THAT THE C&P DEPARTMENT WILL CONTINUE TO BE WELL-POSITIONED TO ACHIEVE ITS CASH GENERATION AND RAW MATERIAL SUPPLIER MISSION.

A. MAC LACHLAN

AM/MBW

JULY 29, 1981