PROPRIETARY

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

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GENERAL

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

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IMPERIAL OIL LIMITED
RESEARCH REQUIREMENTS

INTRODUCTION

This volume describing Imperial's Research requirements is part of an annual planning cycle which starts with the preparation of a Product Quality Forecast. Forecast contains a review of future business and technical trends and should be considered an integral part of the Requirements. The final step in the planning cycle is the preparation of research programs.

The present document is intended to serve a number of purposes. As would be expected it provides a major input for the programs of the Imperial Research Department. It also informs Esso Research of Imperial's needs, and is considered together with similar information from the other affiliates, in planning mutualized programs. However, the preparation is probably of as much value to Imperial as the document itself. It ensures close consultation of knowledgable people in the Logistics, Marketing, and Research Departments in an annual assessment of the state of our technology.

Imperial's Research Requirements deal almost exclusively with new technology that is expected to be needed in view of current business and technical trends. As a result, these requirements are strongly influenced by today's business environment and tend to be relatively short term in nature. It should be emphasized that Imperial also supports a continuing program of longer range basic or exploratory research in areas that appear attractive from both a business and technical viewpoint. This type of research can lead to major improvements or to entirely new products or processes.

IMPERIAL OIL LIMITED OPERATING ENVIRONMENT - 1971

EXTERNAL ENVIRONMENT

As in other countries of the western world, social change is continuing in Canada. Governments are according increasing significance to the individual, his personal importance and his level of living. Steps are being taken to protect consumer interests, to control pollution of air and water, to ensure adequate educational and training facilities, and to eliminate social and regional disparity of opportunity. These are typical of a continuing movement towards the welfare state and of government's involvement in areas long considered the private domain. Despite such trends, free enterprise will continue to be the accepted order because the democratic system will not allow government to insulate itself from the adverse effects of policies that undermine confidence in economic growth and progress. An expanding economy is and will be a political must for Canada. At the same time, discord between English and French speaking Canadians will continue but will not substantially interfere with the general progress of industrial enterprise.

In the market for public opinion business is on the defensive. Public opinion is now little concerned about the problems of productive enterprise and has instead turned its concern to the consequences of that activity. The oil industry in particular has suffered loss of public sympathy from that we have enjoyed over the last two decades. In the 50's and 60's, finding oil, building pipelines, developing markets was "good news". Nowadays, the public sees the development of Arctic oil, its transportation, the sale of natural gas to the U.S. as problem laden issues. This means new areas of concern for all corporate activities and continuing attention must be given to protecting and enhancing the reputation of both Imperial and the industry.

In the political sphere we can assume that the government realizes that the pursuit of social goals can only be accomplished through economic growth. In other words equalization of opportunity or reduction of poverty must be accompanied by jobs which means incentives for economic growth; but, shaping private sector decisions to government-determined national goals means increased government impingement on business through incentives, and concomitant regulation.

We can also be reasonably certain that the government will not force foreign corporations to reduce or divest their ownership of Canadian subsidiaries, however, future foreign takeovers of Canadian companies will be controlled. We will also see greater surveillance of U.S. subsidiaries operating in Canada through balance sheet reporting and pressure to make new equities available to the public.

The economy will expand because it is a political must for Canada. GNP will increase by 6.7% in 1971 and 8.8% in 1972 with the inflationary component of increase equal to 2.5% and 3.8% in 1971 and 1972 respectively, with an upward trend continuing into 1973-74. The lowering in Canadian and world inflation will be slow but eventually policies will be effective although not until the last half of the seventies.

Energy consumption in Canada is expected to increase by 4.8% in 1971, with an average annual growth rate of 4.7% for the period 1970-1980. Petroleum energy demand is expected to increase 4.2% in 1971 and 4.5% for the period 1970-1980. The domestic and export demand for natural gas will increase 13.1% and 19.5% respectively in 1970, while the expected average annual domestic and export growth rate is 6.7% and 9.5% respectively for the period 1970-1980. Natural gas will continue to increase its position in the energy market but at a declining rate. Petroleum's share of the energy market will decline, under continued competition from natural gas, from 54.3% in 1970 to 53.9% in 1980. Nuclear energy, which is currently an insignificant electrical power source is expected to make rapid gains in the 1970's at the expense of coal. Nuclear energy will represent 1.2% of the energy market by 1975, and 1.8% by 1980.

INDUSTRY ENVIRONMENT

Air and water pollution will continue to be at the forefront of both public and political concern with ecological preservation and noise abatement filling any gaps. The most obvious manifestation today of this kind of concern is industry's program for lead reduction and removal in gasoline and the continuing government pressure for reduced sulfur in fuel oil. In addition a Federal clean air act is ready to be tabled while amendments to the Canada Shipping Act will likely place increased responsibility on the cargo owner as well as the ship owner for pollution violations, as well as provide the government with wide powers to regulate shipping and the mechanism to recover clean-up costs.

The National Oil Policy, which makes the area west of the Ottawa Valley the domain of products refined from Canadian crude oil, continues to exist in principle and to be abrogated in practice. Nevertheless it appears that gasoline refined offshore will not enter Ontario again, and it is assumed transfers of gasoline refined from foreign crude into Ontario will be arrested by the end of 1972 while distillate movement will cease by the end of 1974.

Large quantities of oil and gas will be required in the late seventies to meet projected demand by the U.S. On the continental mainland of Canada only the Beaufort Basin has the potential to supply the needed reserves; traditional producing areas having relatively modest undiscovered potential. The Beaufort Basin and the Atlantic Coast are the most likely sources of Canadian offshore oil to meet the needs of the seventies with supply from the Arctic Islands not being available until the eighties due to transportation difficulties. Imperial expects to play a leading role in both the Beaufort and Atlantic areas.

U.S. demand for Canadian crude is expected to increase sharply in 1971 by about 200,000 B/D with similar increases in 1972 and 1973. If the U.S. government permits these Canadian imports transportation and production facilities will need capacity increases. Imperial will benefit significantly from these increased exports.

SUMMARY

SUMMARY OF IMPERIAL'S RESEARCH REQUIREMENTS

A. PETROLEUM PROCESSES

1. Fuels

Product quality response to control of environmental conditions by means of lead free gasoline and low sulphur fuels, is the prime factor dictating fuels products research needs. Lead free mogas increases the incentive to develop additional octane upgrading steps, and improve existing process and equipment performance. Low sulphur fuel production, or elimination of high sulphur fuel components will rely to a degree on development of new technology. The cost to respond to both problems is high. Thus technical activity to permit reintroduction of lead and recovery of sulphur after combustion can be expected. Both business and technical risks are inherent in a refiner's response to environmental control through product quality changes.

B. PETROLEUM PRODUCTS

1. Fuels

The thirteen research requirement proposals covered by this summary are grouped as

Motor Gasoline	4
Middle Distillate	1
Heating Oil Equipment	8

The motor gasoline items are broad in nature covering studies of gasoline volatility and additives and current and future automotive requirements for antiknock quality and air pollution requirements. Further work appears justified to determine low temperature flow characteristics of middle distillates and to improve the laboratory prediction of these characteristics. In the past, one item on burner equipment has been included in the fuels research requirements, but this year seven more detailed items are proposed to emphasize the growing importance of this part of the business and to identify vulnerable areas where technical assistance is needed. No aviation fuel items are included here since adequate coverage is provided by the Marketing Engineering Research Program and by the Aviation Technical Committee of Esso International.

2. Lubricating Base Oils

Higher quality finished oils are needed to satisfy the requirements of more severe operating conditions, and more sophisticated end use equipment. Higher VI low pour base oils with oxidation stability could be additive treated to give the more versatile multi-grade long life finished oils which will be required. Improvement of processing and raw material costs is a continuing objective. By replacing premium TJ 102 crude with cheaper Western Canadian crudes, we could effect savings in raw material costs, and eliminate the complicated supply arrangements, and intermediate

processing at Montreal. Cheaper and more efficient lube processing techniques are needed to replace the traditional phenol extraction and dewaxing methods. We should continue to explore the possibility of making specialty oils that cannot be made by conventional processes from available crude. Imperial should become familiar with reclaiming techniques for possible entry into this field.

3. Engine Oils and Transmission Fluids

Automotive engine modifications designed to meet the more restrictive emission levels will impose higher service requirements on engine oils. Trend to lead free gasoline presents many unknown factors in engine oil performance. Yearly crankcase drain intervals will be introduced shortly, possibly with the 1972 model, necessitating a wider cross-grading. Warranty has been shortened to 12 months/12,000 miles. Improved oils with better anti-wear, detergency, high and low temperature performance and consumption control must be developed. A continuing effort is required based on both conventional and high (130 VI) base stocks. Commercial vehicles will be subjected to more restrictive emission levels beginning 1973. Improved multigraded oils are needed for heavy duty applications. Higher performance 2-cycle oils must be developed. Development in transmission fluids are required to keep pace with manufacturers developments, particularly the centralized system. Immediate research effort is necessary to improve current railway crankcase oil and an accelerated program on Western Canadian base stocks. Development is required for a zero ash gas-engine oil. Suitable fire resistant lubricants are needed for power turbine and centrifugal compressors. Development program on paraffin and/or mixed base oils required for marine trunk piston engine. Better and less time consuming screening tools are required for more timely introduction of new developments into the market.

4. Process Oils

Requests for cable oils, naphthenic and aromatic rubber oils and a low viscosity base oil are included to satisfy a growing industry demand. In spite of the requests, we are not optimistic until such time as there is a change in crude source and/or processing techniques. Interest in car top sealants for railway coal cars is now being shown by certain coal companies and the railways; such a product has been requested. The request for a drawing lubricant for use at the steel mills covers a major change in the requirements of the automotive and appliance industries.

5. Industrial Oils

In this area research is required to take advantage of new knowledge and the latest additive technology to ensure continuing improvement of our products to better serve their intended industrial applications. Environmental protection and low toxicity requirements have added new factors which require research work. Industrial gear oils which are lead free and have improved load carrying antifatigue and thermal stability are needed. Hydraulic oils with improved antifoam, demulsibility and anti-air entrainment are required. Another generation of hydraulic oils with detergency, good demulsibility and capable of prolonging drain intervals at elevated service temperatures is required. Hydraulic oils for all season outdoor service under Arctic conditions with further improvements in temperature viscosity properties are required. Oil in water emulsifiable hydraulic

oils are required by the expanding coal mining and steel industries. Improved rock drill oils, wire rope dressings and semi-fluid gear oils are required in the mining industry. More versatile machine tool lubricants and machine tool lubricants to help reduce disposal problems are required.

6. Greases

Research in this area is required to adapt and expand the use of our new Unirex thickener technology to a wide variety of applications where older types of grease are still in service. Also work to reduce Unirex type grease manufacturing costs is required. Work should commence on the next generation of greases to surpass Unirex properties; these will probably require synthetic base oils. Work on low leakage gear box greases is required. An improved cartridge type open gear lubricant is required to meet competitive activity. Due to environmental protection factors it will be necessary to find substitutes for the sperm oil and lead additives which are now used in many of our grease formulations.

7. Waxes

The latest Research Requirements are not very different from those approved a year ago. A new one has been added "Increasing the Supply of Refined Waxes" in which it is requested that incremental dilution be investigated for the Sarnia operation. In the same vein the one on microcrystalline waxes has been modified to consider, in part, the use of purchased micro waxes in order to free recrystallizer time for the production of increased volumes of the lower melting point refined waxes. Continued research effort is required in the fields of impregnating corrugated cardboard and the various miscellaneous applications. In the wax polymer blend area priority is to be given to the products used in curtain coating. Less time should be spent on the carton coating and flexible package field.

8. Asphalt

The major effort for the paving grades will be directed towards improving the temperature susceptibility of asphalts from light Western Canadian crudes. Three provinces already have specifications which require the use of heavy crudes, using current manufacturing processes, and others may institute similar requirements. This is due to the now generally recognized fact that the use of softer asphalt cements to reduce transverse pavement cracking can be even more effective when these asphalts have low temperature susceptibility. Since mix design also has an influence on pavement performance over the whole service temperature range, work will be continued in this field. Some work is also planned in the area of industrial asphalts, such as the evaluation of new crudes as asphalt sources, the development of new products and the investigation or development of new manufacturing processes.

9. Additives

Additives research is centered on improving or developing additives to allow fuel and lube quality requirements to be satisfied. Close liaison with equipment manufacturers is needed to direct research activity toward the development of suitable additives or additive packages ahead of

demand. The trend toward multi-grade and longer life lubricants requires the development of additives with better thermal stability, improved anti-wear properties, low ash content and improved detergency. More shear stable VI improvers are needed at lower cost. Gasoline additives must be improved or replaced to reduce automotive emissions, and to cope with engine design changes and more severe operating conditions. A continuing research effort is required to develop additional flow improvers for distillate heating fuels, water shedding additives, and new additive packages for diesel and heavy fuels, such as smoke suppressant, injector life improvers, and exhaust deodorant for diesel fuels. Relatively new areas for research endeavour include the development of vapor space rust inhibitors for turbine oils and carbon scavenger additives. A new factor to be considered is the possible need to develop additives which are compatible with future used oil reclamation systems.

C. ENVIRONMENTAL PROTECTION

Public concern regarding environmental problems is being translated into legislation rapidly. Major incidents in 1970 have served to maintain the momentum of environmental awareness. The present trend in legislation will require substantial expenditures to reduce emissions, waste discharge, and the impact on the environment of the products we sell.

The development of reliable criteria for ambient air quality is badly needed to permit realistic emission levels to be defined. The public are confused about the need for lead-free gasoline because of the different positions taken by members of the industry. The requirement for lower sulphur content fuels will likely spread. All facets of oil spill cleanup technology need improvement. Pressure will increase to recycle solid wastes. Nuisance problems due to noise, odour, etc. as distinct from health problems will require increasing attention. Present and future operations in the Arctic will substantially be governed by ecological considerations.

D. BUILDING PRODUCTS

Research effort is required to optimize the yield and quality of woodfibre based products. The move to more stringent fire codes will require the development of fire resistant woodfibre based products. The trend from four ply roofing to two ply roofing will require the development of an asphalt emulsion coated sheet roofing. In addition, it will be necessary to develop an asphalt roofing emulsion with adequate weathering resistant properties. Further research effort will be required to improve the fire rating of continuously produced phenolic foam; faster curing formulations have also to be developed. The work on plastics will be required to establish performance criteria for plastic building materials and to improve our technology in this area.

E. GENERAL ENGINEERING AND MATHEMATICS

Research requirements in this section specify criteria to be used in:

1. Engineering improvement of existing petroleum processes.
2. Chemical engineering technology.
3. Process control and systems engineering.

4. Equipment development and evaluation.
5. Materials engineering.
6. Civil, industrial and utilities engineering.
7. Engineering mathematics.
8. Environmental control.
9. Terminalling research and development.
10. Fire protection and safety.
11. Manuals and services.

PETROLEUM PRODUCTS

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

PETROLEUM PROCESSES AND PRODUCTS

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IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

FUELS PROCESSES CODE 400

I N D E X

1972 RESEARCH REQUIREMENTS - IMPERIAL OIL LTD.

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PREAMBLE

I INTRODUCTION

The fuels processes research requirements of Imperial Oil Limited are reviewed herein. The preamble provides an "overview" of the significant business criteria which will affect our needs, the technical trends, and broad conclusions.

Each fuels processes research category is examined in greater depth in subsequent portions of the report. Economic incentives for future research programs have been provided where possible. In some instances they are best estimates. In others, they are the result of definitive planning studies.

II BUSINESS SUMMARY

Total energy requirements for Canada are forecast to increase by 4% per year over the next 20 years - from 4.2×10^{12} B.T.U.'s in 1970 to 5.1×10^{12} in 1980 and 9.1×10^{12} in 1990. Oil's share of this market will approximate 50%. Residential and commercial needs will grow 3% annually, the industrial and transportation sectors by 4.5% each.

Oil's share in the residential and commercial field will gradually decline. By 1990 it will share equally with natural gas and electricity. In the industrial sector, natural gas will make further inroads. Oil fuel will find increased use in the more remote areas. Great significance is attached to its future potential in electric power generation. All energy requirements for transportation will be supplied by oil.

Protection of the environment is the key to predicting the trend not only of technology but of business decisions. Major contributors to atmospheric pollution are the automotive engine and industrial fossil fuel consumers. The conclusions derived from current studies involving lead-free motor gasoline and low sulphur fuel oils will have a major influence on corporate planning strategy.

An aviation turbo fuel growth of 10%/Year is projected. This equates to 4.2% of total petroleum fuels demand in 1975, and 8.9% in 1990. From an economic viewpoint, a lead-free mogas environment will encourage continuance of supplying the Turbo B product.

Motor gasoline will increase by 4 - 5 % per year during the forecast period, assuming current automotive efficiency. Legislative control of composition and pollution devices could increase this figure.

Middle distillate growth rate is expected to be about 2% per annum. Legislative pressure on sulphur levels is current in major metropolitan areas.

Residual fuels will grow by 6% per annum, based largely on future electrical power needs, primarily in Ontario. Currently about 80% is generated by hydro, and 20% thermally. The nuclear contribution is minor, although there is an active National Development Program. By 1975, the ratios will be 74 hydro, 20 fossil fuel and 6 nuclear. By 1990, the corresponding values will be 44, 24 and 32.

Coal is the predominant fossil fuel for thermal power generation, nationally, although gas and residual fuel play more important roles in Western Canada and the Maritimes respectively. Residual fuels are receiving increased attention for both new and existing installations due to a shortage and high price of low sulphur coal.

Future growth in the residual fuel market is contingent upon solving the sulphur dioxide emission problem. The trend to higher price and premiums for low sulphur fuels represents an attractive business opportunity. Future demands impose problems of investment climate, raw material sources, product volume and quality availability, as well as environmental pollution.

Refinery wastes and emissions are being subjected to continuing closer scruting and control by legislative authorities. Noise attenuation is receiving greater attention.

III TECHNICAL TRENDS

Historically, energy resources have been developed and marketed at a pace dominated by the drive for economic growth. The new ethic may dictate a slower pace as determined by man's concern for his environmental relationships unless compensating technology can be developed.

Current forecasts show an increasing volume requirement for Turbo A aviation fuel. It is expected that Air Canada will continue to use Turbo B. Other carriers express a preference for Turbo A. Safety and B.T.U./weight-volume relationships are reasons cited. Supersonic, high altitude aircraft will require the A type because of volatility and heat-sink requirements. A major shift in demand to the latter type fuel would have a serious impact on future planning decisions.

Current opinion is that lead alkyls will be phased out of motor gasolines in Canada by 1980. An exhaust gas catalytic converter is scheduled for wholesale introduction with 1975 model cars. This device, requiring lead-free mogas, will oxidize unburned hydrocarbons and carbon monoxide. Simultaneous reduction of nitrogen oxides may be achieved by a second catalyst system. E.R.E. have recently announced progress in this direction. Considerable uncertainty exists regarding future mogas quality. Volatility and chemical composition limits may be imposed. It is expected that Canada will adopt similar legislation governing emissions to those imposed by the U.S. Federal authorities because of the reciprocal automotive pact and automobile mobility. Legislation in the U.S. is imminent. This enforces rapid development of emission free mogas technology and attendant processing and blending facilities.

The middle distillate current forecast target of 0.2 wt% sulfur max., in the 1975 period will require provision of some new hydrofining facilities.

Heavy fuel consumption will increase in the mining, steel and pulp and paper industries. Potentially large volume demands exist for power generation. Availability of low sulfur crudes is limited. Growth in the field of thermal power generation is dependent on successful development of desulfurization technology - either of product per se or stack gas. This, in turn, implies a future trend towards hydroskimming rather than conversion refineries. Conceivably, logistics implications may favor locating these future refineries adjacent to the power plant. As an alternative, crude burning may be adopted.

Reduction of refinery generated pollutants - noise, gases, liquids and solids - will involve continuing development of improved techniques.

IV ASSESSMENT AND CONCLUSIONS

Current forecasts do not reflect the possiblity of a major shift from Turbo B to Turbo A aviation fuel. Planning studies incorporate this factor as a sensitivity parameter. Should it develop, Imperial would be faced with a

severe problem in providing future volume and quality requirements. Turbo A type material is needed also to provide low pour requirements for mid distillates. A second hydrocracker, located in Western Canada, is tentatively foreseen for the 1975-80 period. Its design is contingent upon interpretation and resolution of significant trends at least four years in advance. Research to develop an in-house process for saturating cracked fractions to Turbo A quality is recommended as protective strategy.

Cat. Cracking will continue to be employed as a major conversion process. Emphasis here should be on reduction of atmospheric pollutants, treatment and re-use of foul water, economies in investment and operating costs and catalyst development for motor octane improvement of cat. naphtha.

Powerforming will be the fly-wheel of future refining operations. Not only is it the only process for producing large volumes of the high octane aromatics required in a T.E.L. - free environment but it is the prime source of hydrogen which will be required in ever-increasing quantities on an uninterrupted basis. This latter factor demonstrates the need to ensure high service factor. This, coupled with the higher catalyst deactivation rate anticipated for hydrofined cat. naphtha, gives precedence to research involving cyclic rather than semi-regenerative technology. Cat. naphtha powerforming technology is scanty and must be extended. Present correlations need to be extended to define the effects of higher end point feeds on yields, octane distribution, catalyst deactivation and regeneration. Continuing research to develop improved catalysts is encouraged.

Hydrocracking research is of limited interest to Imperial at the moment. The Sarnia Unit is hedged with certain non-disclosure restrictions. Nonetheless, the various metallurgical problems associated with high pressure equipment, evaluation of competitive and development of improved catalysts are areas requiring further research.

Hydrogen will be an increasingly valuable commodity in future operations. An early assessment of the chances for success in effecting manufacturing economics should be made. Engineering guides for evaluating reclamation and purification versus manufacture would be a welcome contribution.

Isomerization is a distinct requirement for future lead-free mogas manufacture. U.O.P.'s Penex process is the current preferred candidate for isomerizing normal pentane and C_6 hydrocarbons. Recycle C_6 isomerization has not been demonstrated commercially. Elaborate feed pretreatment is required to prevent catalyst poisoning. Investment and operating costs are high. Esso Engineering have determined little incentive for developing an in-house process.

Alkylation research has been directed almost entirely to the $H_2 SO_4$ process. Imperial studies favor HF. Effort should be expended to consolidate and correlate data from operating HF units in the Jersey circuit.

Hydrofining technology for cracked naphthas, including methods to control exothermic heat release, is an urgent research requirement since it is directly related to powerforming and lead-free gasoline production. Knowledge in the field of mid-distillate hydrofining to meet future sulfur levels is believed adequate. Past studies of cat. feed and recycle hydrogenation have shown little incentive for Imperial. The determining factor has been the lower mogas/mid distillate ratio, vis-a-vis Humble Oil.

Aqueous waste treatment/disposal involving desalter brine, sour water and spent caustic are continuing, increasingly difficult problems requiring early resolution.

The significance of accelerating demands for residual fuel cannot be over emphasized. Success in resid or stack gas desulfurization research would be of major significance in Imperial's planning and business strategy. The by-product from SO_2 recovery should be elemental sulfur rather than $H_2 SO_4$ in the Canadian scene. It is recommended that some research effort be expended in this direction.

Because of the potential volumes and price structure associated with residual fuel, and the higher costs associated with resid conversion, interest in the latter technical development is marginal at this time. It may, however, be the only solution to handle high metals content residua. Some protective effort in this field is required.

Octane blending calculation procedures and mogas blending facilities, particularly as they involve volatility/octane relationships, require further development as precision tools in the lead-free mogas future.

Exploratory research in upgrading light paraffins, development of a flow improver for residual fuels and in synthetic fuels production is deemed desirable.

CATALYTIC CRACKING 411

BUSINESS SUMMARY

Imperial has eight cat crackers in operation with a total fresh feed capacity of 110,000 B/SD. At present all units are using zeolite catalyst. Operating flexibility is required to maximize naphtha or middle distillate production.

In a lead-free mogas environment, cat cracking and zeolite catalysts will still play an important role in a conversion refinery.

Edmonton Refinery expansions plans include a 41 MB/SD facility by 1974 as one alternative. Other alternatives could delay construction for 6-7 years.

Anti pollution regulations will require expenditures to reduce stack emmissions and reduce noise level.

TECHNICAL SUMMARY

In a lead-free environment cat cracker operating intensity will increase to improve octane.

New active zeolite catalysts have been developed. There is a need for accurate correlations to predict component yields and qualities under varying operating conditions.

Regeneration efficiency needs to be improved to give carbon levels on regenerated catalyst of less than 0.1%.

Need for improved catalyst recovery equipment, catalysts that do not attrit, and reduced velocities in vessels to reduce attrition is required to reduce stack emissions.

Hydrodesulphurization of feed, and/or, recycle may be required to reduce sulphur in stack emissions and cracked products.

CO emissions must also be controlled.

RESEARCH IMPLICATIONS

1. Develop unit design and configurations to optimize use of zeolitic catalyst in existing and new units.

2. Improve technology in regeneration, catalyst entrainment, riser cracking.

3. Provide facilities to evaluate new catalysts, feed stocks and operating conditions.

4. Improve prediction correlations for all types of catalysts.

5. Define process conditions and catalysts to yield improved clear octanes. Should include need and methods for selective naphtha fractionation.

6. Define conditions for maximum naphtha and middle distillate yields through combinations of hydrotreating and cat cracking.

7. Define equipment required to meet future anti-pollution regulation.

FINANCIAL INCENTIVES

A 1% increase in naphtha yield is worth $500,000/Year.

A 10% reduction in catalyst costs is worth $300,000/Year.

A 0.1% reduction in carbon on regenerated catalyst is worth $100,000/Year.

An expenditure of about $9MM, onsite, may be required at Edmonton as early as 1974.

URGENCY

Items 2, 3 and 7 are high priority. Overall, the current emphasis on cat cracking should be continued.

POWERFORMING 412

BUSINESS SUMMARY

Imperial's installed reforming capacity is 50 MB/SD cyclic and 25 MB/SD semi regenerative.

Current lead free studies show that additional reforming will be the first major step to lead-free mogas. New cyclic capacity will be required at Dartmouth (7 MB/SD), Montreal (25 MB/SD), Sarnia (8 MB/SD), Edmonton (up to 30 MB/SD) and Ioco (3 MB/SD).

96 Severity reforming plus aromatics extraction is approximately equal in cost to a 102 Severity plus splitting operation. Each situation must be examined on its own merits.

Future motor gasoline blending and marketing requirements dictate an assured supply of reformate, since this is now the octane flywheel rather than lead. Hence, unit reliability is a paramount need.

TECHNICAL SUMMARY

Current reforming operating problems are related to low service factor which is affected primarily by:

(a) Poor hydrofiner reliability (insufficient equipment)

(b) Regeneration equipment failure

Secondary considerations include:

(a) Corrosion

(b) Furnace and compressor operation

(c) Reactor shroud design

(d) Feed contamination

Future reformer type for Imperial will be cyclic. This is required to ensure a reliable hydrogen supply, and permit operating flexibility.

Recent bi-metallic catalyst developments are not applicable in the cyclic process due to excessive hydrocracking with freshly regenerated catalyst. Thus far, PHF-4 is the only acceptable catalyst for cyclic units.

RESEARCH IMPLICATIONS

1. Develop accurate correlations for:

   - high octane catalyst requirements and C_5 + yields.
   - semi regeneration cycle length
   - high final boiling point feeds, cracked and virgin feed stocks.

   Cat naphtha reforming will be required in a lead-free environment. Additional data are required to define feed treatment and reforming conditions. Data on some virgin stocks are also inadequate.

2. Develop improved catalysts which are cheaper and more selective.

3. Develop improved process equipment and operating methods to improve reliability and reduce operating costs. These should include flow distribution and vapour/solid contacting devices.

4. Evaluate competitive catalysts and technology.

5. Define any problems in the associated aromatics extraction process.

6. Develop method for predicting and scheduling catalyst reworking.

FINANCIAL INCENTIVE

Imperial's expenditures for future powerforming capacity in the seventies will approximate $50MM.

A 2% increase in C_5+ reformate yield is worth approximately $1.5 MM per year, now, rising, to at least $3.0 MM per year in 1980.

Future refining throughput will be tied closely to hydrogen availability.

URGENCY

The scope of the current program should be maintained due to the increased significance of reforming in a lead-free environment. Specifically, Items 1 to 4 have priority.

HYDROCRACKING - 413

BUSINESS SUMMARY

Imperial's first hydrocracker (11,000 B/SD) is being brought on stream at Sarnia Refinery one year behind schedule due to major equipment problems. Serious product supply implications and costs have resulted from the delay.

A second hydrocracker of about 13 MB/SD is indicated as a possiblity by 1975 in Edmonton expansion studies. Design and necessity for this unit will be determined, in part, by future jet fuel market trends.

Low pour distillate needs (kerosine) rather than motor gasoline will be the influencing factor for a hydrocracker installation. Alternatively upgrading of cat heating oil to kerosine via hydrotreating (or mild hydrocracking) may have potential.

TECHNICAL SUMMARY

Major prestart-up problems of a mechanical nature have been encountered with:

a) Cracks in heavy walled vessels.

b) Compressors.

c) High pressure airfin cooler headers (hydrogen leakage).

These problems have been general throughout industry.

Until the unit has operated for an extended period, it is premature to comment on operations or our ability to predict performance.

RESEARCH IMPLICATIONS

1. Continue with the program to improve metallurgical technology of thick walled vessels.

2. Continue correlations work -
   - effect of feed stock properties
   - catalyst requirements
   - cycle lengths
   - operational flexibility

3. Evaluate E.R.E. vs U.O.P. catalysts.

FINANCIAL INCENTIVES

A capital expenditure of $20 MM at Edmonton in the 1975-78 period is a possibility.

The successful performance of zeolite cat cracking catalyst has deferred major incentives for hydrocracking except where low pour limitations occur.

URGENCY

Imperial assigns a low priority to work in this field, at this time.

ALKYLATION

BUSINESS SUMMARY

Three alkylation units are installed in Imperial refineries. Edmonton at 2.3 MB/SD and Winnipeg at 1.2 MB/SD are HF units. Calgary at 1.0 MB/SD is sulphuric acid. Future alkylation needs have been identified as a 7500 B/SD unit for Sarnia in 1974, and up to 8500 B/SD for Edmonton in 1975/76. In addition, due to motor gasoline quality restrictions, it is likely that future capacity additions at Montreal and Ioco will include alkylation as a supplement to cat cracking rather than polymerization.

TECHNICAL SUMMARY

The prime operating problem with existing equipment is HF stripping in packed towers. Improvement is required. Drying is a problem that could be improved through better facilities and monitoring procedures and equipment.

Should light olefins restrictions be applied to mogas, a need for pentene alkylation would materialize.

Future unit designs must recognize butadiene and sulphur contaminants. These affect acid consumption and regeneration costs. Better definition is required to optimize pretreatment facilities, and related process selection.

A recent process evaluation by Imperial favours HF over sulphuric acid in a Canadian environment. Future concern will be directed at waste disposal from either process.

Alkylation or isomerization is required to meet volatility and octane distribution requirements in premium grade lead free mogas.

RESEARCH IMPLICATIONS

1. Develop correlations to show effect of HF process variables
   - IC_4: olefin ratio
   - Acid strength, contaminants and diluents
   - Reactor design and temperature
2. Improve equipment design:
   - HF regeneration
   - HF strippers
   - Fractionation towers with HF in feed

3. Develop improved materials:
   - Valve packing and grease
   - Instrumentation
   - Vessel linings

4. Develop a new solid alkylation catalyst.

5. Improve waste disposal techniques.

FINANCIAL INCENTIVE

Imperial's two future units will cost approximately $15MM.

Current acid consumption costs are about $100M/Year for the HF Units. A 65% saving is considered possible. This equates to $65M/Year.

Incentives for a new zeolitic type catalyst include a volume increase from 170% to the 180-220% range on olefin according to recent literature and a potential major reduction in pollution problems.

URGENCY

Alkylation will play an increased role in the lead-free environment and the research program in this area should be upgraded.

Item 1 is the most important factor for immediate development.

ISOMERIZATION

BUSINESS SUMMARY

Low emission mogas studies point up the need for pentane and hexane isomerization in the 1975-1980 period. Two pentane recycle units of 1M and 3 MB/SD and three hexane recycle plants of 6M, 5M and 4 MB/SD are projected for Eastern Canada, assuming no expansion of refining capacity. A 4 MB/SD unit is planned for Western Canada. Investment and operating costs for the process are very high. Fully paid royalty for the 22,000 B/SD total capacity is estimated at about $1.5 MM. Treated as a capital cost, depreciated over 15 years at 15% after tax return, royalties have been calculated at about 2¢ and 4¢/B respectively for normal pentane and for hexane isomerization.

TECHNICAL SUMMARY

Low octane nC_5 and C_6 Isomers have four alternative dispositions in the lead-free mogas environment:

1) Refinery fuel

2) Chemicals Feed

3) Turbo B Jet Fuel

4) Upgrading (via Isomerization)

As low sulfur refinery fuel, the material is worth about $2.50/B. As 92 Octane clear mogas it is worth about $6.00/B. Hexane Isomerization is less attractive, economically, than pentane Isomerization. It does however, provide for lower sensitivity and the front end octane required in future T.E.L. - free Grade I mogas formulations. Alkylation partially fulfills this requirement but does nothing to reduce the light paraffins surplus.

The Hydro-isomerization process is catalyst dependent.

The desired Isomer equilibrium distribution is favoured by lower temperatures.

A large part of the costs involved in Isomerization is associated with separation of the desired and recycle of the unwanted Isomer(s).

Both Imperial and E.R.E. studies indicate the U.O.P. Penex Process to be superior to competition, including a potential Esso Process.

Factors which could increase Imperial's isomerization requirements are:

A switch from Turbo B to Turbo A by Air Canada and R.C.A.F.

Restrictions on mogas aromatics contents.

RESEARCH IMPLICATIONS

1. Cheapen the Isomerization process.
2. Improve catalyst.
3. Improve separation techniques.
4. Provide better design criteria.

FINANCIAL INCENTIVE

Anticipated capital costs for isomerization are in the $20-25 MM range.

If paid-up royalties could be eliminated the indicated saving of $1.5 MM would have a present worth of $1 MM, discounted at 8% over a five year period.

URGENCY

With savings of the indicated magnitude, Imperial cannot support a significant program to develop an in-house process. However, effort should be expended to obtain greater expertise in this field.

HYDROGEN - 417

BUSINESS SUMMARY

Except for Sarnia, all I.O.L. Refineries depend on powerforming for hydrogen availability. Hydrogen needs are growing through increased fuel sulphur removal requirements, hexane isomerization in a lead-free mogas environment, a trend towards higher sulphur crudes, particularly in Eastern Canada, and installation of hydrocrackers.

Many of our refineries will be out of hydrogen balance in the 1975-1980 period. Hydrogen will become an increasingly valuable by-product, and will determine overall refinery service factor.

TECHNICAL SUMMARY

Hydrogen is available via:

Gas or naphtha reforming (HO+ ¢/MSCF)

Improved recovery and utilization of current production.

Increased powerforming.

RESEARCH IMPLICATIONS

1. An early assessment of chances for success in lowering current H_2 manufacturing costs should be made.
2. Engineering guides for evaluation of reclaiming and purification techniques vs manufacture should be prepared.
3. Hydrogen availability is tied to catalytic reformer service factor. Further work to improve service factor may be warranted.

FINANCIAL INCENTIVES

At the present time Imperial sees a need for only one hydrogen manufacturing facility (at Edmonton) between now and 1976. There exists a possibility that an additional unit may be required at Montreal in 1977. Lower cost H_2 manufacture would have direct application.

The balance of the refineries will have their hydrogen needs satisfied through increased reforming capabilities.

URGENCY

A research program directed towards improved utilization of hydrogen, and maintenance of supply would have immediate use and application.

HYDROFINING AND TREATING - 421/423

BUSINESS SUMMARY

Environmental concern is expected to force refiners to install additional hydrofining facilities. At present, Imperial has 8 hydrofiners for preparing powerformer feed and 10 units for desulphurizing middle distillates, with an overall capacity of about 180 MB/SD. Two additional hydrofiners are planned to desulphurize furnace fuel components at Dartmouth and Montreal. Also in the planning stage are hydrofiners to process greater volumes of powerformer feeds, including cat naphtha. New hydrofining capacity planned in the next 5 years will exceed 100 MB/SD.

The growth rate for aviation turbo fuels is projected at 10% per year. Increased volumes of Turbo A fuel will be required. Any major shift in demand from the B to the A type impact on future refinery processing. The alternatives to increase kerosine supply include hydrocracking, and saturation of cracked stocks by hydrotreating.

Chemical treating has been supplanted by hydrofining to a large extent. However, there are still cases where some type of caustic treating will be required. The disposal of spent caustics, sour water and desalter brines containing sulphides, ammonia and phenolics is becoming an increasingly acute problem.

TECHNICAL SUMMARY

Present hydrofining technology is probably adequate to meet Imperial's forecast middle distillate sulphur target of 0.2 wt%. However, some demonstration runs will be necessary for unusual feedstocks and for firming up design criteria.

There is a great need for data on hydrofining cracked naphthas for subsequent powerforming. Engineering research on effective schemes to control the high exothermic heat release is warranted.

Longer powerformer runs are essential to ensure availability of hydrogen for other processing units. Preheat fouling of the integrated hydrofiners has, at times, severely limited run lengths. New hydrofiner designs should incorporate techniques, developed by past research and engineering studies, for improving hydrofiner service factor.

Imperial has some interest in hydrotreating heavy cat recycle oil and cat feed. The interest level is uncertain until the benefits are more clearly defined for specific refining situations.

Upgrading of cracked stocks to Turbo A quality fuel via hydrotreating has not been demonstrated.

Opportunities for cost reduction are related to development of more active catalysts to permit operating at lower pressures, temperatures and higher space velocities. Other design innovations appear to be limited in this relatively mature process.

Imperial strongly recommends research in devising new and improved methods to alleviate the disposal and pollution problems associated with spent caustics, sour waters and other waste liquids.

RESEARCH IMPLICATIONS

1. Develop process and engineering data for the design of economical and efficient cat naphtha hydrofiners.

2. Provide adequate information to permit meeting Imperial's future sulphur specification of 0.2 wt% on mid distillates.

3. Develop techniques for saturation of cracked stocks to Turbo A aviation fuel.

4. Devise new and improved anti-pollution methods for disposal of spent caustics, sour waters and other waste liquids.

5. Conduct exploratory catalyst research to discover more active desulphurization and denitrogenation catalysts.

FINANCIAL INCENTIVE

A 10% cost reduction applicable to planned new units is conservately estimated at $3 MM, with a present worth of $1.8 MM, discounted at 10% over 5 years.

Upgrading of cat heating oil to Turbo A quality is equivalent to roughly $1.0/B.

A program to dispose of spent caustics to possible consumers is being developed. Success will be dependent, largely, on purity. Research incentive will be governed by the costs associated with the alternative means of disposal.

URGENCY

Items 1 and 4 are high priority items. An early evaluation of Item 3 is recommended.

FUEL OIL DESULFURIZATION - 422

RESID CONVERSION - 424

FLUE GAS DESULFURIZATION - 425

BUSINESS SUMMARY

Residual fuel demands double every 10-12 years. In order to maintain status quo SO_2 emissions from this source, either its sulfur content must be reduced by 50% over the same period or means must be found to remove SO_2 from flue gases.

- The supply of low sulfur crudes is limited.
- Future demands for residual fuel loom large.
- Control of SO_2 emissions is the major determinant.
- Restricted availability, higher product prices in the short range and premiums for lower sulfur content fuels all affect future business strategy.

A general trend to lower sulfur content fuel oils is forecast in major metropolitan areas. No significant problems are anticipated for those refineries processing Western Canadian crude. In Quebec and the Maritimes, the uncertainties of crude supply affect the long range supply strategy to be employed in meeting quality needs.

Specifically, Imperial's residual market in the Ontario - Quebec region could be increased from 23 to 36 million barrels in 1975 and to 49 million barrels in 1980, given a guaranteed source of supply and quality. Of the total volume, 12 - 15% would be at 3 wt% 67 - 75% at 1 wt%, the balance at 0.5 - 0.75 wt% sulfur. The incremental volumes reflect opportunities for thermal generation of electric power. Alternatively, a developed flue gas desulfurization process would permit marketing increased volumes at 3 wt% sulfur.

In 1975, dependent on crude slate, Montreal is scheduled to import from 20 - 35% of its residual fuel requirements as low sulfur flux stock in order to meet sulfur specifications. At $0.20/B non-recoverable differential between flux and 1% sulfur fuel, the associated debit is between 0.4 and 0.6 million dollars. Fluxing rather than desulphurization has been chosen due to possible future crude slate uncertainties.

Flue gas desulfurization costs have been quoted at from 25¢ to 60¢ per barrel of fuel oil. Residfining is estimated to cost upwards of 55¢/B, dependent on crude source and scale of operations.

The current premium of 60¢/BBL for 1% over 3% sulfur fuel represents the incentive for successful development of desulfurization technology or crude burning.

Discovery of New Venture crude of low sulfur content at an attractive price is the offsetting disincentive.

Increasing recovery of SO_2 as H_2SO_4 from smelter gases and other relatively rich sources, high transportation costs for the product and localized end use provide limited economic outlet for H_2SO_4 recovered from the combustion of fossil fuels. Recovery of the by-product as elemental sulfur is a more attractive prospect in the Canadian scene.

TECHNICAL SUMMARY

The simplest and cheapest solution to the SO_2 emission problem would seem to rest on commercialization of an economic, universal flue gas desulfurization process. However, it is probable that, if and when developed, application will be limited to large fuel consuming installations. There would still appear to be a need for fuel desulfurization.

Vacuum distillation of atmospheric resid and Gofining of the vacuum gas oil is limited to about 35% desulfurization - not good enough for most crudes unless an outlet for some high sulfur product can be established.

Recent economic studies have shown that for high sulfur, high metals crudes a Gofining/Flexicoking combination is superior to Residfining (The Flexicoking process has been developed to pioneer license status). Residfining has the edge for low metals, moderate sulfur level crudes.

The I.F.P. hydrodesulfurization/conversion process is stated to effect 70% desulfurization of an atmospheric residue of 2.65 wt% sulfur, containing 210 ppm metals. In-situ regeneration of catalyst, with an ultimate life of 11 months is claimed. Feed to gas oil conversion of up to 40% is effected. Operating costs, including depreciation and return are, roughly, 75¢/B feed.

Imperial Research has demonstrated a viable technique for desulfurizing low metals content whole crudes at 800 psig. No recent cost estimates are available but 1968 costs for the Rainbow crude case, translated in toto to fuel oil, amounted to about 60¢/B.

RESEARCH IMPLICATIONS

1. Extend flue-gas process to bring out by-product as elemental sulfur, not sulfuric acid.

2. Extend Residfining capability to higher metals resids. This may involve demetallization prior to desulfurization.

3. Study application of resid desulfurization technology to whole crudes.

4. Continue to survey potential for a resid hydrodesulfurization/ conversion process.

5. Continue search and development of improved Residfining catalyst.

6. Pursue search for a non-hydrodesulfurization process.

FINANCIAL INCENTIVE

The present price differential between 3% and 1% sulfur fuel implies that Resid, desulfurization costs, including return on investment, cannot exceed $0.60/B.

URGENCY

Imperial's interest in this area is associated, primarily, with its eastern refineries and as such is tempered by a possible swing to sweet Canadian crude. Hence there is no current identified application. Nonetheless, research programs in these areas are supported. Broad recommendations are:

- Increase present level of effort in flue gas desulfurization.

- Maintain present level of effort in Residfining.

- Consider reduced effort in Flexicoking until the process is commercialized. No applications are foreseen for Imperial.

EXPLORATORY 481/483

UPGRADE SURPLUS LIGHT FRACTIONS

BUSINESS SUMMARY

In a lead-free environment, increased crude running and powerforming will tend to generate surplus quantities of light paraffins which cannot be incorporated directly in the fuels pool. Alternative dispositions are to chemicals feedstock (limited), refinery fuel and as isomerization feed stocks.

TECHNICAL SUMMARY

Normal pentane and hexanes can be upgraded via isomerization to future mogas quality requirements although the associated investment and operating costs are high.

Surplus normal butane can likewise be isomerized to alkylation feed stock in the event of an iso-butane shortage.

No economic process is available for upgrading propane or ethane for fuels products.

RESEARCH IMPLICATIONS

Develop superior processes to upgrade light paraffins to mogas quality.

FINANCIAL INCENTIVE

Light paraffins, as refinery fuel, are worth from $2.00-2.50/B based on current price of 1 wt% sulfur bunker fuel. 92 octane mogas is worth approximately $6.00/B.

URGENCY

Successful development could preempt isomerization now projected in the 1975-1978 period.

EXPLORATORY 481/483

FLOW IMPROVER FOR RESIDUAL FUELS, HEAVY CRUDES

BUSINESS SUMMARY

Current planning studies indicate that Imperial will import, by tanker, up to 3.8 million barrels of residual fuel into the Montreal supply area in 1975, up to 6.0 million barrels in 1980. If it were possible to import at Portland followed by pipe-line transfer to Montreal, considerable freight savings could be realized.

Large growth in demand for residual fuel is anticipated for thermal power generation. Single installations are expected to consume up to 100,000 barrels per day. Here, also, the potential for pipe-line movement versus alternative delivery methods could be of significant economic benefit.

Similarly, development of a flow modifier would find application in pipe-lining heavy crudes which, normally, require addition of flux stock to achieve required mobility.

TECHNICAL SUMMARY

Residual fuels and heavy crudes do not meet the maximum viscosity limitation of 100 S.S.U. at 100°F stipulated for long haul pipe-line transport. Development of a modifier to impart flow properties to these materials equivalent to conventional crude oil is desirable. Any such flow improver would have to be compatible with crude or petroleum products.

RESEARCH IMPLICATIONS

Search for a flow modifier/improver.

FINANCIAL INCENTIVE

Planning studies have shown that such an additive would complement a hydroskimming installation in either Eastern or Western Canada. Although no present plans exist for such a facility, incentives of 25-30¢/barrel of heavy fuel can be shown for direct pipe-line transfer versus unit train or fluxing to pipe-line viscosity requirement.

The differential between direct ship movement into the Montreal area versus tanker to Portland then pipe-line to Montreal is estimated at 10-12¢/barrel at world scale tanker rates of 200.

URGENCY

Successful development would find immediate application.

EXPLORATORY 481/483

SYNTHETIC CRUDES

BUSINESS SUMMARY

As Free World energy demands are growing in an atmosphere of tightening crude supplies, price structures are being pushed higher. For example, heavy fuel oil prices have risen to levels that could hardly have been predicted several years ago. This situation should tend to accelerate the development of synthetic fuels from tar sands, shale oil and even coal.

Imperial is currently processing 5 MB/SD of GCOS synthetic crude at Edmonton refinery. This material is rich in low pour components but suffers deficiencies as diesel fuel and cat feed. Currently, it is being tested by CPR as railroad diesel fuel and could thereby seriously affect Imperial's market share of this product.

Imperial has a 30% participation in Syncrude Canada Ltd.

TECHNICAL SUMMARY

The current and future development of synthetic fuels from tar sands, shale oil and coal has a need for research into optimum economical processing of the raw materials into synthetic crude mixes that meet refiners' product requirement slates. The need for this research already exists. In the U.S. an energy shortage is developing.

Imperial has participated in research and feasibility studies involving recovery and upgrading of Athabaska bitumen through participation in Syncrude. The primary upgrading step considered is hydro-visbreaking, a joint development of H.R.I. and Cities Service. Hydro-treating of the raw product is required, involving high hydrogen requirements.

RESEARCH IMPLICATIONS

1. Develop a low cost, flexible reliable process for production of synthetic crudes from tar sands, shale or coal.

2. Develop improved hydrosulphurization/denitrogenation catalysts for treating raw synthetic crude.

3. Develop lower cost hydrogen manufacture.

FINANCIAL INCENTIVE

Successful commercialization of synthetic crude production from tar sands has been hindered by the high costs associated with its production, reflected in the differential cost of 34¢/B between the GCOS product and Alberta par crude (32° API, 1% S). The incentive for production is related directly to energy demands, crude availability and crude pricing, hence cannot be quantified at this time.

URGENCY

More economic production techniques or more favourable pricing will advance commercialization.

PETROLEUM PRODUCTS

FOREWORD

The business, technical and quality forecast background to the research requirements for each of the petroleum products sections (except additives) is covered in detail in the

LONG RANGE PETROLEUM PRODUCTS OUTLOOK
PRODUCT QUALITY FORECAST
1971 to 1974
1975 and 1980

and therefore, has not been included as a part of this publication.

Copies of this product quality forecast, if required, may be obtained from the

Secretary,
Technical Development Committee,
Room 1632,
111 St. Clair Avenue West,
Toronto, Ontario.
(Local 408)

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

FUEL PRODUCTS

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Gasoline Octane Quality

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research ..X..

DEFINITION OF REQUIREMENT

Follow trends in the automotive industry and competitive developments within the oil industry to ensure that current quality is maintained at satisfactory levels and that realistic projections of future octane quality requirements can be made for planning purposes. Road octane requirement and octane requirement increase of new cars designed for low lead or lead free gasoline is of great concern in planning future fuels. A continuing assessment of progress in the development of engines insensitive to octane quality (steam, gas turbine) must be made to justify future investments in octane capacity.

SIGNIFICANCE TO COMPANY

Motor gasoline is the company's largest volume product and is probably used directly by more consumers than any other. It is essential that octane quality be fully competitive and satisfy a high percentage of vehicles on the road. On the other hand, quality giveaway is expensive and should be minimized. Anticipation of rapid development of octane insensitive engines would avoid unnecessary investments in processing equipment.

INCENTIVE

An increase of one unit in road octane number on both grades of gasoline would cost Imperial about $3,000,000/year.

URGENCY

There is a continuing need for the above data and it is essential that it be kept up-to-date. Commercial exploitation of technological advances requires a lead time of up to four years.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Gasoline Volatility Specifications

CLASSIFICATION New Product or Process ..... Cost Reduction.....
Improved Product or Process ....X.... Exploratory Research ....X..

DEFINITION OF REQUIREMENT

A continuing research effort is required to evolve realistic gasoline volatility specifications which will ensure good year-round starting, fast warm-up with minimum driveability problems and freedom from vapourlock with due regard to the low temperatures (-30°F to -40°F) encountered during the Canadian winter.

This study should also establish the minimum volatility limits for acceptable vehicle performance under Canadian conditions in the event that gasoline volatility is restricted to control evaporative emissions.

A better definition of gasoline volatility requirements and limitations would assist in the choice of future refinery conversion capacity and chemical projects based on the extraction of components from the motor gasoline streams.

SIGNIFICANCE TO COMPANY

Gasoline volatility determines several engine performance benefits which are apparent with the first gallon of fuel consumed and which make a significant contribution to customer satisfaction year round. These qualities are of increased importance in currently produced lean-mixture emission-controlled cars. The limitations on volatility must be defined to ensure that performance is not impaired beyond acceptable limits by compromises imposed by refinery production economics or chemical requirements.

INCENTIVE

The cost to Imperial of lowering the R.V.P. of motor gasolines by 1 lb. would be approximately $3.3MM/yr. The cost to Imperial due to unrealistic restrictions on choice of refinery conversion capacity and future chemical business could be considerable.

URGENCY

This is a basic continuing requirement which can influence future process selection and operation. This requirement would become more urgent if restrictive volatility levels are legislated.

RESEARCH REQUIREMENTS

Planning Group: Fuels Date: November, 1970

Source: Marketing

Title: Air Pollution from Automobiles

Classification:

New Product or Process ____ Cost Reduction ____

Improved Product or Process X Exploratory Research X

Definition of Requirement

More stringent control of vehicle emissions could force the imposition of severe and costly restrictions on future gasoline composition and additives. It is important that sound data be obtained to confirm or challenge the need for such restrictions in the interest of public health. We should initiate efforts, and preferentially cooperate with the automobile industry to develop engine accessories or modifications which would clearly provide lower cost alternatives to drastic changes in gasoline composition.

Significance to the Company

Controls on the volatility, olefins, aromatics, lead and particulate matter of gasolines would severely limit our ability to manufacture gasolines and would require heavy investment for new processing equipment.

Financial Incentive

Motor gasolines are the largest source of Marketing sales income.

Urgency

Events in the field of automotive air pollution are moving rapidly. It is urgent that a knowledge of the effect of gasoline composition and additives on the quantity and toxicity of emissions be acquired to counter possible unnecessary and costly modifications.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Gasoline Additives

CLASSIFICATION

New Product or Process		Cost Reduction.....	
Improved Product or Process	X	Exploratory Research	X

DEFINITION OF REQUIREMENT

New or improved gasoline additives should be developed to reduce exhaust emissions or to reduce any undesirable side effects of engine modifications made to meet pollution regulations.

More effective gasoline additive packages to reduce total engine deposits and intake valve deposits in particular would be desirable as would improved control of engine wear and rusting. The application to Imperial gasolines of additives to improve fuel-air mixture distribution in the engine should be investigated. Development of a safe, low cost anti-stall additive package should continue.

SIGNIFICANCE TO COMPANY

Proprietary additives with demonstrable benefits afford a better opportunity to attract and keep customers than new developments in processing technology which are generally available to all refiners.

INCENTIVE

Effective additives could increase sales and reduce the risk of drastic changes to gasoline composition to control vehicle emissions.

URGENCY

Competitive activity is high and early leadership in this field would be beneficial to sales.

RESEARCH REQUIREMENTS

Planning Group: Fuels Date: November 1970

Source: Marketing

Title: Tests to Predict Flow Characteristics of Distillate Fuels Containing Pour Depressant

Classification:

New Product or Process ____ Cost Reduction ____

Improved Product or Process ____ Exploratory Research X

Definition of Requirement

Reliable laboratory tests are required which will correlate with the low-temperature performance of distillate fuels containing pour depressant.

Significance to the Company

Pour depressed fuels are marketed on a basis which is restricted partly by the lack of confidence in field performance. An improved test could expand the use of the pour depressant additive.

Financial Incentive

Cannot be quantified but could eliminate customer complaints and claims with potential loss of business. Could also eliminate any other abnormal field expense.

Urgency

The Imperial filtrability test procedure now developed needs further evaluation and correlation in the field.

RESEARCH REQUIREMENTS

Planning Group: Fuels Date: November 1970

Source: Marketing

Title: Design of Domestic Heating Units

Classification:

New Product or Process ____ Cost Reduction X

Improved Product or Process X Exploratory Research ____

Definition of Requirement

To be competitive with natural gas in many parts of Canada, it is necessary to have lower cost, quieter oil burners, furnaces, storage tanks and vents. The American Petroleum Institute and National Oil Fuel Institute sponsor research on this subject. This work should be followed and appropriate developments investigated by Imperial and/or Esso.

Significance to the Company

Houses utilizing oil-fired central heating units are expected to drop from the present 60% of Ontario households to 40% in 1980. Ontario, Quebec, and British Columbia are markets where oil and natural gas are competitive in price. In these locations, lower cost heating units are required.

Financial Incentive

Distillate heating fuels represent 15-20% of Imperial's gross marketing income.

Urgency

Marketing contacts are continually being pressured for better tools and techniques to improve our competitive position.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE Nov. 1970

TITLE Evaluation of The Aquathermic Water Heater and Potential Alternative

CLASSIFICATION New Product or Process ..... Cost Reduction...X.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

An accurate assessment of the durability and operating capabilities of the present Aquathermic domestic water heater are required.

SIGNIFICANCE TO COMPANY

Imperial has an extensive rental program for water heaters in which the forecast return is based upon some estimate of the life of the units and the cost of their maintenance and repair while they are in operation. Miscalculation of the costs of operation or replacement could result in considerable financial loss. Advertising claims for this equipment need to be substantiated to avoid potential problems with the Department of Consumer Affairs.

INCENTIVE

Imperial has about 10,000 water heaters rented to customers. At a cost of about $200 each, investment is about two million dollars. Return is based upon a projected life of ten years and some annual cost for maintenance and replacement of parts.

URGENCY

No reliable information is available to yield reasonable assurance that the projected ten year life will be achieved and there is considerable doubt that it can be realized. Furthermore, there have been numerous reports of component failures in service which raise considerable doubt regarding the accuracy of the costs allowed for maintenance and repair. Appraisals of field performance are in progress but a more thorough appraisal of the performance capabilities and the durability of this unit is urgent.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing **DATE** Nov. 1970

TITLE Evaluation of Unaspray Integrated Warm Air Furnace

CLASSIFICATION New Product or Process ..... Cost Reduction.....X.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

The Rocketdyne Division of North American Rockwell Corp. have developed a new warm air furnace under contract from The National Fuel Oil Institute (USA) which they claim to be less expensive, more efficient and easier (thus cheaper) to service than conventional equipment. A need exists to evaluate these claims quantitatively considering their source (NOFI).

SIGNIFICANCE TO COMPANY

Any reduction in the cost of the warm air furnace will increase the competition which fuel oil can offer to natural gas, particularly in the new home market. Easier or less frequent routine maintenance will make possible savings in the cost of our burner service plan. This unit would probably be able to obtain CSA and UL approval for use with a B vent chimney thus substantially decreasing the cost of oil fired equipment in new homes. Reductions in smoke at start and stop would be favourable developments meeting with the approval (and perhaps being necessitated) by air pollution control authorities.

INCENTIVE

Imperial annual sales of about 10,000 warm air furnaces are the basis of any savings in equipment costs. A savings of $30.00 per unit (about 10% of present cost) represents a total of $300,000 per year. This savings might be largely retained based on present sales volume or extended to the customer with the intention of increasing the share of the domestic heating market supplied by oil from the present 45%. If service costs could be decreased by $3/year on equipment such as The Unaspray, this would amount to $30,000 in the first year of total sales of such equipment, with annual increments of about this magnitude.

URGENCY

Urgency is that inspired by the potential savings and any restrictions which may be imposed by air pollution control.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE Nov. 1970

TITLE Evaluation of Chevron Research Combined Domestic Water Heater and Warm Air Space Heater

CLASSIFICATION New Product or Process ..... Cost Reduction....X.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Combination of a domestic water heater and a warm air space heater would be an advantage to oil heating equipment by reducing the capital cost of such facilities to the homeowner, thus enabling fuel oil to obtain a greater share of the market amongst new single family homes including mobile homes and row housing.

SIGNIFICANCE TO COMPANY

There are about two million single family homes in Canada centrally heated by oil and sales of domestic oil fired heating equipment is about 90,000 units annually. An increasing percentage of single family homes are mobile or row housing units requiring relatively small space heating capacity. Development of a unit which can supply both hot water for domestic use and warm air for space heating would offer Imperial an opportunity to increase percentage of market through the possession of a unique unit, and would permit the oil industry to offer more competition to natural gas, both in the new home and older home (replacement) market

INCENTIVE

Where equipment is offered for new homes, a combined water and space heater should be less costly than two individual units by about $100. A portion of this savings could be retained by the company as increased profit or passed on to the builder with the objective of increasing the market for fuel oil relative to natural gas, primarily in Eastern Canada and British Columbia.

URGENCY

The urgency is that inspired by the potential savings which might amount to 5,000 units annually (estimated portion of total Imperial sales to new homes) at a savings of perhaps $100 each, for a total of 1/2 million dollars. It is doubtful if the entire potential saving could be retained.

Any urgency assigned to this product must be tempered by the need for a very thorough and quantitative appraisal of the probable durability and performance of these units because of unfavourable experience many years ago.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE Nov. 1970

TITLE Investigation of Potential Warm Air Furnace Designs

CLASSIFICATION New Product or Process ..... Cost Reduction.....
X
Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

The existing product line of warm air furnaces sold by Imperial, while not unsatisfactory in their operation, are relatively large and bulky and less efficient, particularly with regard to high flue gas exit temperatures, than is possible or desirable in the present marketing climate. An investigation of the availability of more suitable equipment is required.

SIGNIFICANCE TO COMPANY

The only significance at present is any advertising benefit which might be derived from a more compact, efficient unit. Should the B vent (a relatively cheap chimney) be approved for use with oil fired equipment, it seems likely that our present warm air furnaces could not be used with such a vent because of their high exit gas temperatures.

INCENTIVE

The only financial incentive would be derived from an ability to offer a warm air furnace for use with a B vent (if it is approved) which would result in a lower cost oil fired heating package and a greater ability to compete with natural gas on new installations.

URGENCY

Presently, there is little urgency since competitive units are not remarkably better nor has the situation vis a vis natural gas changed lately. Investigations of this nature would be intended to ensure that our equipment line reflects the optimum choice between desirable characteristics and economy from available alternatives.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Investigation of Suitable Alternative Oil Burner Designs

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X.... Exploratory Research .....

DEFINITION OF REQUIREMENT

The existing burner (Model 40) while more efficient than its predecessor (C10) is suspected of greater sensitivity to draft changes and to greater deterioration in performance under low draft conditions. A need exists to prove quantitatively that our present equipment represents the best choice for Imperial amongst available alternatives.

SIGNIFICANCE TO COMPANY

The Model 40 burner is being installed on over 20,000 units of oil fired equipment annually. Lack of extended accelerated laboratory testing or a program of field trial admits the possibility (not necessarily probability) of future unexpected operating difficulties with attendant costs to the Company for increased service or unit replacement. A more thorough investigation of the Model 40 burner and the best alternatives available would permit greater confidence in its merit relative to alternative designs, and its long range performance and durability. The probability of satisfying possible future pollution control requirements also is unknown.

INCENTIVE

Financial incentive cannot be predicted since no means of estimating probable repair or replacement cost exists because of lack of sufficient pre-market testing.

URGENCY

Since the Model 40 burner is not radically different in design, the probability of catastrophic operating experience would seem low. However, the large number of these units being delivered to customers increases the magnitude of any potential problems and could justify the expressed need for a more sophisticated pre-marketing test program.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Investigation of Alternative Oil Fired Equipment Designs

CLASSIFICATION New Product or Process ..... Cost Reduction.....X.....

Improved Product or Process ....X.. Exploratory Research .....

DEFINITION OF REQUIREMENT

Status of equipment marketed by Imperial relative to competition has never been quantified. Some investigation would seem to be justified in order to be sure that our equipment represents the optimum choice between performance and economy that is possible from units available in our market place.

SIGNIFICANCE TO COMPANY

Assurance that the large amounts of money invested in rental equipment are providing the maximum benefit. Assurance that the equipment which we sell adequately reflects the reputation which we wish to achieve in the market.

INCENTIVE

Difficult to quantify.

URGENCY

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Development of Means of Introduction of Alkaline Metallic Oxides into Residual Fuels Used by Small Consumers

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

Low temperature (acid) corrosion is an almost universal problem suffered by the small consumer of residual fuel oils, particularly when boilers are used intermittently. The alkaline metal oxides appear to be a means of arresting acid corrosion due to condensation of flue gas or wetting of sulphate deposits but materials do not appear to be available which will remain suspended in the fuel during storage nor does a satisfactory mechanical means of injecting these materials into fuel lines appear to exist. A means of extending the use of these additives to the smaller user of residual fuels is required.

SIGNIFICANCE TO COMPANY

Possible royalties might be obtainable from the development of a suitable mechanical system or a suspension of the effective materials which would not settle appreciably in storage. Other benefit to company would be the ability to satisfy problems which are widespread amongst customers and amongst the foremost difficulties associated with the use of residual fuel oils.

INCENTIVE

Possibility of profit from the sale of any product or process which might be developed or the ability to change a small premium for fuel oil sold with a suitable additive.

URGENCY

The problem is long standing.

RESEARCH REQUIREMENTS

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Aviation Fuels Quality

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process X Exploratory Research X

DEFINITION OF REQUIREMENT

Follow trends in the aviation industry and competitive developments in the oil industry to ensure our aviation fuel quality is maintained at satisfactory levels and that realistic projections of future quality requirements can be made for planning purposes.

SIGNIFICANCE TO THE COMPANY

The growth rate of aviation fuels is about 9.5% per year representing the highest of any petroleum product. By 1975, aviation fuels will represent 4.2% of all petroleum fuels.

FINANCIAL INCENTIVE

An unexpected change of fuel quality from Turbo Fuel B to Turbo Fuel A would require major capital investment or large volume imports.

URGENCY

This is a continuing requirement.

RESEARCH REQUIREMENTS

PLANNING GROUP Fuels

SOURCE Marketing DATE November 1970

TITLE Diesel Fuel Additives

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process X Exploratory Research _____

DEFINITION OF REQUIREMENT

Air pollution considerations has increased the interest in additives for diesel fuel which will reduce engine exhaust smoke and odour. Field evaluation of the Imperial diesel additive and other promising additives should be continued.

SIGNIFICANCE TO THE COMPANY

Although industry diesel fuel sales are increasing at a rate greater than for motor gasolines, Imperial's share of this market is decreasing. The development of an acceptable fuel additive would help in reversing this trend. The company prestige in developing an antipollution additive would be considerable.

FINANCIAL INCENTIVE

The use of "premium diesel fuel" is increasing in popularity in United States and some Canadian cities are already paying a premium price for high quality fuel.

URGENCY

Several additives have already been evaluated, and the Imperial developed detergent is now being tested. Customer enquiries concerning diesel air pollution are increasing.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

LUBRICATING BASE OILS

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP : Lube Base Oils

SOURCE : Planning Group DATE: November 1970

TITLE : Develop the Use of Western Canadian Crudes for LCT Distillates

CLASSIFICATION : New Product Process X Cost Reduction X

Improved Product or Process ____ Exploratory Research __

DEFINITION OF REQUIREMENT

Imperial's naphthenic base oils are made from TJ-102 crude and carry a cost of raw material premium over Western Canadian crude derived lubes. Continued research is required to prove out the acceptability of substituting W. Canadian base oils.

SIGNIFICANCE TO COMPANY

Imperial processes about 2 MM bbls/year of TJ-102 crude at Montreal to produce distillates for movement to Sarnia. The possible substitution of base oils from W. Canadian crudes would effect savings in raw material cost and operating complexities. It would also allow Edmonton to make products now moved to W. Can. from Sarnia.

INCENTIVE

40% of Imperial's E. Can. lube supply is derived from TJ-102. Disruptions in supply of TJ-102 would have a serious effect on lube profitability.

URGENCY

Partial substitution (high viscosity grades ex RD) of W. Can. crude for TJ-102 will be possible at Sarnia when dewaxing capacity becomes available mid 1972.

RESEARCH REQUIREMENTS

PLANNING GROUP : Lube Base Oils

SOURCE : Planning Group DATE: November 1970

TITLE : Improved Lube Processes and Crude Utilization

CLASSIFICATION : New Product or Process __ Cost Reduction __
Improved Product or Process X Exploratory Research __

DEFINITION OF REQUIREMENT

Hydrotreating Prior to Extraction

Lube extraction feedstocks can be up-graded by hydrotreating to match or even surpass premium lube crudes for the manufacture of lube basestocks. Studies are required to assess the potential of this lube processing sequence.

Hydrotreating (To Replace Extraction)

Previous studies showed 1500 psig hydrotreating is cost/quality competitive with grass roots phenolfining for making industrial type lubes such as LCT's and paraffin bases. Some highly active and unusual catalysts have recently been uncovered. These should improve economics and product quality aspects. Their potential should be explored.

Improved Lube Processes

Technological advances in extraction and dewaxing could affect our competitiveness. More selective solvents and better contacting methods in solvent extraction and new chilling and filtering methods (including filter aids) in dewaxing are needed.

SIGNIFICANCE TO COMPANY

Hydrotreating and Prehydrotreating

- debottlenecking potential plus up-graded fuels products
- higher yields from premium naphthenic crudes
- independence from premium paraffinic crudes
- eliminate the need to segregate fuels/lubes crudes as currently practiced at Sarnia

Improved Lube Processes

- lower operating costs
- delayed investment

INCENTIVE

Low cost capacity additions will be needed at both Edmonton and Sarnia. Edmonton's lube plant will be out of capacity in 1972 and Sarnia's new plant faces an $8 - 9 MM capital outlay in 1976.

URGENCY

Technology to reduce costs would be used when available; the significance of prehydrotreating should be resolved by 1973.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP : Base Oil

SOURCE : Planning Group DATE: November 1970

TITLE : Improved Base Oil Quality

CLASSIFICATION : New Product or Process X Cost Reduction ____

Improved Product or Process ___ Exploratory Research X

DEFINITION OF REQUIREMENT

Base stocks with greatly increased oxidation resistance are needed (See Engine Oils and Industrial Oil Research Requirements). Work has to be done in the area of petroleum lube oils to determine the optimum amounts and types of sulphur containing compounds and the effect of various hydrocarbons on oxidation resistance and inhibitor response. Hydrocarbon base stocks with a natural high V.I. (>130) are available from (for example) hydrocarbon petroleum fractions or by synthesis. Supplies of these base oils are needed and work must be done to evaluate their usefulness relative to V.I. improved oils.

SIGNIFICANCE TO COMPANY

Separation processes more efficient than solvent refining may be possible when the desired hydrocarbon composition of base oils is better defined. Technology defining the advantages of high V.I. base stocks versus V.I. improved oils is needed for both offensive and defensive marketing.

INCENTIVE

Superior product quality.

URGENCY

Knowledge re oxidation could be applied at once; samples of oils needed first quarter of 1971; their evaluation completed in 1971.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP : Base Oil

SOURCE : Research DATE: November 1970

TITLE : New Base Stock Specifications

CLASSIFICATION : New Product or Process ____ Cost Reduction X

Improved Product or Process__ Exploratory Research ___

DEFINITION OF REQUIREMENT

Our current base oil specifications contain no performance requirements and are only a very rough guide to lube operations when changes in processes or crudes are required. More meaningful specifications are needed.

SIGNIFICANCE TO COMPANY

Better control of base oil quality will result while allowing somewhat more flexibility in lube processing.

INCENTIVE

Lower costs should result as well as more uniform product quality.

URGENCY

By end of 1971.

RESEARCH REQUIREMENTS

PLANNING GROUP : Lube Base Oils

SOURCE : Planning Group DATE: November 1970

TITLE : Waste Oil Reclaiming

CLASSIFICATION : New Product or Process _____ Cost Reduction _____

Improved Product or Process ___ Exploratory Research X

DEFINITION OF REQUIREMENT

It is anticipated that environmental control regulations will soon prohibit current methods of disposal of waste oils. Also, a situation appears to be developing wherein it will be necessary that Imperial arrange for disposal of used oil from its customers. Therefore, methods of reclaiming must be developed which are economic but do not contribute to environmental pollution.

SIGNIFICANCE TO COMPANY

- once pollution regulations are enacted, lube oil sales will be dependent on taking back a percentage of the volume of used oil.
- use of reclaiming by competitive oil majors could make inroads into Imperial's lube oil sales.

INCENTIVES

Sales maintenance coupled with pollution abatement.

URGENCY

Immediate.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP : Lube Base Oils

SOURCE : Planning Group DATE: November 1970

TITLE : Base Oils for Arctic Service

CLASSIFICATION : New Product or Process X Cost Reduction ____

Improved Product or Process ____ Exploratory Research ____

DEFINITION OF REQUIREMENT

Increasing industrial activity in the Arctic region will demand lubricants and specialty oils for severe low-temperature service. Expanding military, industrial and automotive uses are foreseen. Today the most likely contenders for this service are high cost imported synthetic oils.

Mobil already has synthetic hydrocarbon lubricants designed for Arctic service and available in Alaska. These are of at least 120 VI and -65° F pour, and high cost. A few years ago, Research made exploratory oils with similar properties but of potentially lower cost. Based on the anticipated increasing demand and the competitive situation, there is a need to re-evaluate and update this technology and develop oils for Arctic use.

SIGNIFICANCE TO COMPANY

Place company in a competitive situation relative to increasing northern markets.

INCENTIVE

Could be considerable if a superior, low-cost product is developed.

URGENCY

Develop as soon as possible. Competition is already very active.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

ENGINE OILS AND TRANSMISSION FLUIDS

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Engine Oils/Transmission Fluids

SOURCE: Planning Group DATE: November 1970

TITLE: Service Station Crankcase Oils

CLASSIFICATION

New Product or Process..... Cost Reduction.....

Improved Product or Process ..X.. Exploratory Research.....

DEFINITION OF REQUIREMENT

The introduction of lead free gasolines may necessitate different performance requirements for service station oils. Engine and correlated field testing of motor oil formulations as related to unleaded gasolines is required to evaluate (1) deposit formation (2) wear (3) oil service life (4) octane increase requirement. Removal of lead from the gasoline will place increased emphasis on the oil ash in the combustion chamber deposits.

Require:
(1) Lower ash oils - 0.5 S.Ash max. 1972
- 0.0 S.Ash max. 1974
(2) Improved combustion chamber deposit control
(3) Improved anti-wear properties (valve guide, power zone)
(4) Improved low temperature fluidity consistent with low oil consumption
(5) Evaluate crankcase oil performance in annual and no drain service
(6) Evaluate effect of lube oil on HC emissions
(7) Assess competitive product quality

SIGNIFICANCE TO COMPANY

Oils meeting the above requirements are essential to maintain Imperial's marketing target of leadership. Also required to meet future emission levels for pollution control.

INCENTIVE

IOL Volume 170MB; Share 18%; Growth Rate (-1.5%): Gross Margin $7,200M. Required to protect share and margin.

URGENCY

Required to meet the January 1972 and 1974 targets respectively.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group DATE November 1970

TITLE Commercial Crankcase Oils

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....
Improved Product or Process .....X..... Exploratory Research .....

DEFINITION OF REQUIREMENT

New Requirements

1. An oil meeting Caterpillar Series 4 (approx. 1973)
2. An Arctic grade (5W/20 or 5W/30) oil with MIL-L-2104C performance (1972)

Improved Products for Existing Requirements

1. Develop diesel oils with demonstrated performance in both single and multi-grade in the following areas:
   - comply with all major engine manufacturers' requirements and existing specifications
   - improved power zone wear and deposit level
   - improved low temperature fluidity
2. Develop to lower ash (below 1.0%)
3. Assess competitive product quality
4. Attempts will be made to satisfy the majority of requirements with the Essolube HD, HDX and D-3 line. However, specialized products may be required.

General

1. Develop improved low cost screening tests to facilitate economical and adequate evaluation and development, particularly in the areas of deposits and wear.
2. Establish tests and control limits for used oils where new component combinations are involved.

SIGNIFICANCE TO COMPANY

Required to meet Imperial's quality targets and to remain competitive.

INCENTIVE

IOL Volume 408MB; Share 39%; Growth Rate 4%; Gross Margin $6850M

Required to meet Imperial's targets of retaining market share and profitability.

URGENCY

Continuing development of new products as required.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group **DATE** November 1970

TITLE Synthetic Type Crankcase Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research ..X...

DEFINITION OF REQUIREMENT

One of the next major advances in crankcase oils may be the use of basestocks having a high (130+) natural V.I. Process Research is presently engaged in developing the best methods of manufacturing such basestocks. The performance of these basestocks are currently being evaluated to determine the benefits, if any. If encouraging, work on the crankcase oil blends utilizing these stocks will be carried out in 1971-72 followed by field testing in 1972-73.

Crankcase oils of high natural V.I. should have several quality advantages over conventional products. These may include,

1. Improved engine cleanliness (less V.I. improver)
2. Improved anti-wear properties
3. Longer service life
4. Improved operating temperature range, particularly low temperature performance
5. Lower oil consumption

SIGNIFICANCE TO COMPANY

Excellent marketing appeal because of novelty, recognizable quality advantages and possible grade reduction. Development required to maintain leading position in motor oil development.

INCENTIVE

Customer prepared to pay premium for novel approach and added performance.

URGENCY

Continuing development program required to meet marketing and advertising purposes.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group DATE November 1970

TITLE 2 Cycle Oils (Fuel Mix)

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

The growth of the pleasure snow vehicle and boat market is increasing, particularly in the higher horsepower range.

Continued researching of new additives for outboard oils to ensure Imperial's competitive position in the general marketplace. Must be "BIA Certified" against API service TC-W.

Development of Imperial's air cooled engine oil was based on test work in an 8.5 hp engine. There is a need to continue this study and develop lubricants which give low wear, deposit control, pre-ignition control and low spark plug fouling in engines of the current higher power output. Must be "BIA Certified" against API service TC-A, when released

SIGNIFICANCE TO COMPANY

Currently, Imperial's 2 cycle oils are widely accepted in the pleasure and commercial marketplace. An image builder.

INCENTIVE

Imperial Oil volume 19MB; share 25%; Growth Rate 5%; Gross Margin $420M.

URGENCY

Continuing. High performance outboard oil required for 1971 season. High performance snowmobile oil required for 1971-72 season.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group **DATE** November 1970

TITLE Transmission Fluids

CLASSIFICATION

New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... X Exploratory Research .....

DEFINITION OF REQUIREMENT

1. A centralized system ATF type fluid for factory fill approval, initially for G.M. While meeting Dexron and power steering pump test requirements, much improved fluidity at low temperatures (possible viscosity at -40°F of 10,000 or lower cps) will be needed.
2. ATF formulations for Chrysler and G.M. which will obtain factory fill approval.
3. A torque fluid with better fluidity at low temperatures relative to current TF 56 to overcome sluggish operation and seal popping at start-up in winter operation with combined transmission, hydraulic and power steering systems.

SIGNIFICANCE TO COMPANY

1. A fluid is required to meet Imperial's marketing target of providing complete service at Esso service stations.
2. Required to meet Marketing's policy of participating in the factory fill market and to keep abreast of rapid advances in the automotive industry. Participation will drop to below 10% till the new lube plant is in operation.
3. To meet the requirements for a premium product.

INCENTIVE

Excluding Factory Fill: IOL Volume 27MB; Share 22%; Growth Rate 6%; Gross Margin $650M

Factory Fill: IOL Volume 19MB; Share 56%; Growth Rate 3%; Gross Margin $7M
(Share will drop to 10% until new lube plant comes into operation with corresponding drop in volume and margin).

URGENCY

(1) Required by mid 1973
(2) To meet 1973 requirements with the coming on stream of the new lube plant
(3) As soon as available

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group DATE November 1970

TITLE Railway Crankcase Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..X..... Exploratory Research .....

DEFINITION OF REQUIREMENT

The trend to higher unit horsepower and BMEP, without major engine modification by the engine builders, is presenting a challenge to the oil industry to significantly improve present railway oils. This is compounded by the railways' determination to appreciably extend the present engine overhaul periods.

At the time Galena RD-40 was introduced as a second generation oil, it proved to be the best oil for the horsepower available to the railways. However, since then, horsepower has dramatically increased and improved competitive third generation oils are being marketed. According to the engine builders some of these new oils appear to be superior to Imperial's Galena RD-40 in bench and field tests.

The developments required to meet the demands of the current and future engines include:

1. Upgrading of the current product by:
   - Improved wear protection including power zone and top deck pins and bushings
   - Improved ring zone deposit levels and general engine cleanliness
   - Improved thermal stability and better base number retention
2. Accelerate the development program with the use of Western Canadian basestocks. The development of Western Canadian basestocks could have an important effect in the above-mentioned problem areas.

SIGNIFICANCE TO THE COMPANY

The development of an improved oil would:

1. Protect our current high market share of 65%.
2. If developed with Western Canadian basestocks, it would provide a better profit margin by using lower cost base oils at Sarnia and permit manufacturing at Edmonton, thus reducing freight costs. The improved distribution pattern will allow us to remain in a competitive marketing position by being more attractive to our railways in Western Canada.

INCENTIVE

IOL volume 104MB; Share 65%; Growth Rate 1%, Gross Margin $365M.

Recognized improvement in quality would increase the gross margin to $500,000 plus. Western Canadian basestocks would further improve margin.

URGENCY

1. An improved product is required by 1972.
2. The development of Western Canadian basestocks should be accelerated so a field test program can be initiated in 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group **DATE** November 1970

TITLE Crankcase Oils for Gas Engines

CLASSIFICATION

New Product or Process	Cost Reduction.....
Improved Product or Process	X Exploratory Research .....

DEFINITION OF REQUIREMENT

Continue investigation of new additives, particularly zero ash, to improve performance in current engines and meet the needs of future more critical designs. The product must satisfy stationary and automotive engines in gaseous fuel service and be suitable for gas compressors where an SAE 30 grade is accepted.

Confirm filterability, establish tests and control limits for used oils where new ingredient combinations are involved.

SIGNIFICANCE TO COMPANY

Required to attain a leading quality position for Imperial in these applications. Our current additives are available to competition making it possible for them to match quality without development cost. Imperial Marketing must have the option to exercise exclusive rights until maximum market share is realized.

INCENTIVE

IOL Volume 20MB; Share 67%; Growth Rate 4%; Gross Margin $230M Required to hold position.

URGENCY

Urgently required to prevent erosion of market share. Field test to commence March 1971, commercialization 2-3 years thereafter.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group **DATE** November 1970

TITLE IIIc Bench Screening Test

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research ..X..

DEFINITION OF REQUIREMENT

With the upgrading by the Automobile Manufacturers of the requirements for crankcase lubricants they have introduced a new engine test procedure, the IIIc Test. This is basically an oxidation stability test therefore it should be possible to develop a simple bench screening test to predict performance in this engine test.

SIGNIFICANCE TO COMPANY

A simple bench test will enable a large number of oils to be screened in order to develop the technology needed for an oil to give good performance in this IIIc Test.

INCENTIVE

A single MS IIIc Test costs $2700.

URGENCY

SE performance for oils will be needed in 1971.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group DATE November 1970

TITLE Effect of Basicity/Acidity on Wear

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research ..x...

DEFINITION OF REQUIREMENT

The trend to higher output engines continues to place increased emphasis on wear rates.

A thorough investigation should be made to identify the significance of base number on engine wear and corrosion control with various fuels and engine metallurgy; identify acids formed from combustion and oil degradation; identify meaningful control tests and establish definitive limits for basicity and acidity. The effect of moisture contamination should be included in these investigations.

SIGNIFICANCE TO COMPANY

Required to maintain product quality superiority in formulations and to supply used oil quality control guidance to customers.

INCENTIVE

Maintain high market share.

URGENCY

A continuing requirement as new additive types and applications are developed.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group **DATE** November 1970

TITLE Effect of Oil Ash on Engine Performance

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research ..X..

DEFINITION OF REQUIREMENT

Work is required to identify the effect on engine performance of oil derived ash with respect to deposit quantity, composition and nature; i.e. friability, tenaciousness, hardness, thermal and electrical conductivity, chemical reactivity with other materials present in locations where deposits occur:

(a) valves from deposit indentation and burnishing; or if applicable, the benefits from surface coating protection.
(b) preignition, detonation and octane requirement.
(c) cylinders and rings from corrosion, erosion and abrasion.
(d) spark plug fouling.

SIGNIFICANCE TO COMPANY

Required in the development of crankcase oils to thoroughly understand their performance under the increasingly more sensitive operating conditions.

INCENTIVE

To maintain or improve quality and market position.

URGENCY

Continuing.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group DATE November 1970

TITLE Filter Requirements of High Dispersant Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research ....X.

DEFINITION OF REQUIREMENT

Investigate factors affecting the filterability of oils containing high dispersant (organic) type additives e.g. particle size, nitration, polarization, water contamination or static electrical phenomena and aging. It is required to establish the effect new oils will have on filters before their introduction.

SIGNIFICANCE TO COMPANY

Required to offer customer guidance in filter requirements and change recommendations to ensure that no significant oil and filter incompatibility will occur.

INCENTIVE

Provide customer service and protect against unjustified claims.

URGENCY

For current and new products as developed.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Engine Oils/Transmission Fluids

SOURCE Planning Group **DATE** November 1970

TITLE Test Methods for Evaluating New and Used Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research ..X..

DEFINITION OF REQUIREMENT

Investigation to be undertaken to identify adequacy of existent new and used oil tests for new additive combinations and where deemed necessary to devise new meaningful tests, to identify used oil limits and provide monitoring control for manufacturing of new oils. Practical tests for used oil quality control giving quick meaningful results are required for:

1. On-site use by customer,
2. Laboratory use by Imperial where product performance monitoring is advantageous.

SIGNIFICANCE TO COMPANY

Required to safeguard the company and customer in the use of our products and for the evaluation of performance of our products in service.

INCENTIVE

Maintain our leading position of technical knowhow and protect against unjustified claims.

URGENCY

For current and new products as developed.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

PROCESS OILS

INDEX

* The requirement for a drawing lubricant (trigger oil) for use in rolling mills was not mentioned in the Product Quality Forecast 1971-1974. The following therefore, provides some background to the research requirements for this product.

Considerable interest is being shown for sheet steel that is precoated with a drawing lubricant at the steel mill. The current lubricant consists of an acrylic polymer coating covered with a rust protective oil film. Wide-scale use is expected and this will lead to the elimination of drawing lubricant requirements by the automotive, appliance and similar industries.

Since Imperial is not basic in acrylic polymers it may not be possible to economically supply this part of the system. However, a suitable rust preventive oil (trigger oil) would still be required to work with a competitive polymer.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Process Oil

SOURCE Planning Group DATE January, 1971

TITLE Electrical Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

1. Uninhibited transformer oil with oxidation properties superior to Voltesso 35 is needed. This oil should have the physical properties of Voltesso 35.
2. Two cable oils are needed; light coloured oil with viscosity at 100°F of 45 SUS and excellent resistance to gassing; a product having a viscosity at 100°F of about 2,000 SUS and which also has a high specific gravity and compatibility with resins. Both of these oils are aromatic.
3. A product of transformer oil quality having a pour point of -80°F and a viscosity at 100°F of 38 SUS. (For circuit breakers).

SIGNIFICANCE TO COMPANY

Imperial sells about 110M barrels of electrical oils per year. This is also a high growth area.

INCENTIVE

Transformer oil business is currently valued at $300M gross margin. The cable oils and low-viscosity circuit breaker oil represent new business.

URGENCY

A market exists for these oils now.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Process Oils

SOURCE Planning Group **DATE** January, 1971

TITLE Rubber Oils

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

1. Government regulations pertaining to manufactured tires will make quality control of process oils essential. Work should be undertaken to see what control can be effected.
2. An aromatic extender oil is needed. If an approval is obtained on the re-extracted Western Canadian extracts then work should be done to improve the resistance of this oil to oxidation. Oils of even greater aromaticity with minimum paraffin content and lower content of polar compounds would be required as second generation products.
3. A naphthenic type oil is needed having an aromatic content of about 50% and having light colour (ASTM L 1.5) and being colour stable. Viscosity grades required: 85 SUS at 210, 150 SUS at 100 and 1000 SUS at 100°F.
4. In those aromatic process oils which are essentially raw naphthenic extracts it may be necessary to produce products with lower acid numbers, polar contents and metallic compounds.
5. Some more fundamental work may be required to relate oil composition and its effect on rubber quality to support the above work.

SIGNIFICANCE TO THE COMPANY

There is about 210M barrels of rubber oil business in this country and Imperial has a low share of this market due to our non-participation in the extender oil market. It is very important that we obtain more business in this area to upgrade extracts from cat-feed value.

INCENTIVE

The gross margin on the extender oil business is estimated at about $250M.

URGENCY

Required immediately.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Process Oils

SOURCE Planning Group DATE January 1971

TITLE Develop a Low Viscosity Base Oil for Special Process Application.

CLASSIFICATION New Product or Process ..... X ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

A replacement product for currently imported Mentor 29. The properties of the product include viscosity SUS @ 100°F of 40 to 45, +20 Saybolt colour, 250 Min. Flash and a boiling range of approximately 500 to 600°F. Low pour point and low aromatics content are also required.

SIGNIFICANCE TO COMPANY

There is a market of approximately 1 MMIG of this product which Imperial could acquire. Current sales volume is 400 MIG. The product is used as a metal working lubricant, in household and industrial chemical formulation, horticulture sprays, and gas absorber oils.

INCENTIVE

Current selling price f.o.b. Sarnia is 28¢/IG, while the import price is 22¢/IG. Against this alternative supply, and noting a 1 MMIG potential market, a product candidate should be evaluated.

URGENCY

Required now. The market exists and Imperial currently supplies by importation; a potential profit opportunity.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Process Oils

SOURCE Planning Group DATE January 1971

TITLE To develop a product for sealing coal cars to prevent wind erosion.

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

With the large shipments of coal from the Alberta/B.C. border areas to Vancouver, en route to Japan, considerable quantities of coal will be lost by wind erosion. A product is required that will seal the tops of rail cars and be able to cope with the setting of the coal that occurs in transit.

SIGNIFICANCE TO COMPANY

New business.

INCENTIVE

If a satisfactory product can be developed at about $2 per car treating costs, total sales could reach #300M by 1972.

URGENCY

Required now as product could be sold immediately.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Process Oils

SOURCE Planning Group DATE January 1971

TITLE Drawing Lubricant (Trigger Oil)

CLASSIFICATION New Product or Process ..... X ..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

The steel industry in both Canada and the U.S. is being forced to apply a drawing lubricant to the steel at the mill. The material currently available is an acrylic polymer that is coated with a rust preventive oil. We need a replacement for both the polymer and the rust preventive if possible but a reasonably priced rust preventive oil would be acceptable to the customers.

SIGNIFICANCE TO COMPANY

Imperial currently is not in the drawing lubricant business. This would be an excellent chance to get in and it is far easier to deal with a few large technically competent customers than a host of little ones.

INCENTIVE

This is new business and we have a chance to get in almost on the ground floor. Potential is excellent since present application rates are approximately 2#/ton of polymer and 1/2#/ton of oil.

URGENCY

Required now.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

INDUSTRIAL OIL AND GREASES

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE Hydraulic Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ....X.... Exploratory Research .....

DEFINITION OF REQUIREMENT

The following developments in hydraulic oils are needed.

1. Low leakage characteristics to reduce pollution and wastage.
2. Wider operating temperature range fluids.
3. Detergent hydraulic oil to overcome valve sticking and improve oil life in high temperature service.
4. An oil in water emulsifiable oil meeting the NCB specification. Good lubricity and emulsion stability must be retained with addition of ethylene glycol.
5. Better anti-wear properties at higher temperatures and higher fluid pressures are required.

SIGNIFICANCE TO COMPANY

Hydraulic oils are 25% of our total industrial oil sales and represent the highest growth rate (15%).

INCENTIVE

We presently sell 2.2 MM gallons of hydraulic oils at a gross margin of $500 M.

URGENCY

Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE Industrial Gear Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

1. A line of industrial gear oils is required with improved load carrying and high temperature stability properties. This requirement is accompanied by the need to remove lead and sulphurized sperm oil.

2. Multi-grade versions of industrial gear oils are required for applications where a wide temperature range must be satisfied with one oil.

SIGNIFICANCE TO COMPANY

Imperial supplies a large volume of oils for industrial gear and journal bearing lubrication. The above improvements are needed to maintain our share of this market.

INCENTIVE

Volume of Pen-O-Led and MM oils is 1.0 MM gal. giving a gross margin of $220 M.

URGENCY

Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE Wire Rope Lubricants

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Develop improved formulations for both stranding lubricants used by rope manufacturers and rope dressings used by rope customers. Lubricants that will increase wire rope life and reduce application frequency are needed. Simultaneously the additive types in both stranding and dressing lubricants should be chosen to have similar ingredients.

SIGNIFICANCE TO COMPANY

Wire rope users are trending towards specifying quality lubricants rather than allowing manufacturers to make ropes with low cost commodity type products. Development of superior lubricants will promote this trend.

INCENTIVE

Protect our present market of 750 M pounds and increase profit margin.

URGENCY

Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE New Additive Technology

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Development of additives for the following is needed:

1. Additives to replace lead and eliminate lead pollution hazard.
2. Additives to replace sulphurized sperm oil which may become unavailable during 1971.
3. Additives to replace sulphurized mineral oil giving equivalent or better E.P. and A.W. properties. Our sulphurizing plant pollutes with H_2S and we have a 1972 deadline to overcome this.
4. Better additives and blending procedures to improve foaming and air entrainment properties.
5. A rust inhibitor that is compatible with ZDDP.
6. Vapour phase inhibitor additive for circulating oils.

SIGNIFICANCE TO COMPANY

1, 2, and 3 - Necessary to comply with environmental conservation requirements.

4, 5, and 6 - Necessary to match or improve on competitive quality.

INCENTIVE

Protect our present market for the major portion of our industrial oils and greases.

URGENCY

2 and 4 - Required by 1971.

1, 3, 5, and 6 - Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE Rock Drill Oils

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Develop formulations for Arox rock drill oils to increase rock drill life and reduce oil consumption.

SIGNIFICANCE TO COMPANY

Imperial supplies 200 M gals. of Arox oils plus 150 M gals. of numbered oils to Inco. Competitive oil is being sold at a premium price based on performance claims. Improvements are needed to maintain or increase our share of this market.

INCENTIVE

We presently sell 380 M gallons at a gross margin of $110 M. We can increase both the volume of sales and the margin with an improved product.

URGENCY

Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE Multi Purpose Machine Tool Lubricant

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

In order to simplify machine shop lubrication requirements there is an opportunity in developing a multi purpose product that will be suitable for the ways, hydraulic system, gear units, and oil mist lubricated bearings. Other desirable features would include protection against rusting if contaminated with soluble cutting oil and the ability to emulsify with soluble cutting oil to eliminate tramp oil.

SIGNIFICANCE TO COMPANY

There is a large and growing market for machine shop lubricants which is trending toward commodity purchasing with the greater acceptance of industrial standards, e.g. AGMA, ASLE, etc. Innovative developments are required to stop this trend.

INCENTIVE

Protect our present market estimated at 1 MM gallons and increase profit margin.

URGENCY

Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group **DATE** January, 1971

TITLE Open Gear Lubricant (Grease type)

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

Imperial presently purchases a grease type open gear dressing (cartridges) and hence have a product only equal to competition. Also, this product has not been improved in ten years and appears to be becoming borderline in many applications. We therefore, require an improved product available in additional grades to serve wider application ranges.

SIGNIFICANCE TO COMPANY

Although open gear dressings are a relatively small volume, they represent a prestige product in which we do not enjoy our normal market share having lost to specialty suppliers.

INCENTIVE

To regain our market share in this highly profitable specialty market by at least doubling sales volumes. Present sales 40 M lbs. at 73¢/lb. gross margin.

To increase profitability by 10¢/lb. by manufacturing our own product.

URGENCY

Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Industrial Lubricants

SOURCE Planning Group DATE January, 1971

TITLE Gear Box Grease

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....

Improved Product or Process ..... Exploratory Research .....

DEFINITION OF REQUIREMENT

Due to the extensive expansion of the coal mining industry in Western Canada the demand for a semi-fluid grease for gear reducer lubrication has grown rapidly. Also, the need to reduce leakage so that maintenance and pollution are decreased will lead to even greater usage of semi-fluid greases in gear units. Nebula EP5F is presently satisfying this requirement but a product less affected by water, coal dust, contaminants and with a lower manufacturing cost is required.

SIGNIFICANCE TO COMPANY

Imperial must fully satisfy this requirement to prevent competitive inroads and also be the leader in promoting new markets for this type of lubricant.

INCENTIVE

Market growth has been:
1968 45M lbs.
1969 115M lbs.
1970(est) 300M lbs.
at a gross margin of 10¢/lb.

URGENCY

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Grease

SOURCE Planning Group **DATE** January 1, 1971

TITLE Next Generation Grease

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Work should commence on the next generation greases to surpass our new Unirex line in high temperature performance. Properties required include:

(i) dispensability from centralized lubrication systems.
(ii) NLGI spindle life of 400 hr (min) at 400°F and anti-fatigue properties.
(iii) water tolerance, corrosion and wear preventive properties and EP properties.
(iv) mechanical stability and maintenance of its consistency over a wide temperature range.

SIGNIFICANCE TO COMPANY

A sizeable demand for greases with these capabilities will develop as inexpensive commodity bearings for service at 400°F become available in the next 10 years. Probably will require synthetic lubricant bases.

INCENTIVE

Not assessable.

URGENCY

Work should commence in 1971.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Grease

SOURCE Planning Group DATE January, 1971

TITLE Unirex Type Products

CLASSIFICATION New Product or Process .....X..... Cost Reduction....X.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

A. Exploit Unirex thickener technology to:

(1) Upgrade existing brands by reformulating with new thickener (e.g. Unitol), or modified thickener (e.g. Ronek).

(2) Develop new products (e.g. GM wheel bearing grease 6031 M and EP version of Unirex N-3 for railway wheel bearings).

B. Modify or consolidate existing greases in Unirex line.

C. Continue work to reduce manufacturing costs of Unirex type greases.

SIGNIFICANCE TO COMPANY

Broad utilization of this new thickener system will permit Imperial to increase the profitability of existing business and allow us to secure a major share of new business in a wide variety of market sectors.

INCENTIVE

Unirex sales for 1971 are estimated at 300 M lbs. at a gross margin of 14¢/lb.

URGENCY

Must proceed in 1971.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Grease

SOURCE: Planning Group DATE January 1971

TITLE: Solid Lubricants

CLASSIFICATION: New Product or Process ---x--- Cost Reduction -----

Improved Product or Process ------ Exploratory Research -----

DEFINITION OF REQUIREMENT

Solid lubricants are used in specific applications where operating conditions preclude the use of conventional oils and greases (Nuclear power plants). New technology indicates this could be a field of growing importance.

SIGNIFICANCE TO COMPANY

The Company's position as a lubricant supplier would be protected and enhanced if solid lubricants were developed for specific applications.

FINANCIAL INCENTIVE

Unknown. Relatively small volume and high-priced now.

URGENCY

Long range project. Should be started now.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

WAXES

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Wax DATE January, 1971

SOURCE Marketing

TITLE Increasing the Supply of Refined Wax

CLASSIFICATION

New Product or Process	X	Cost Reduction	X
Improved Product or Process	X	Exploratory Research	

DEFINITION OF REQUIREMENT

The Sarnia Wax Plant is at capacity and market forecasts indicate considerably more refined wax will be required in future years. Possibilities exist for increasing production in the Recrystallizer by introducing the incremental dilution technique, or by integrating dilchill dewaxing and deoiling operations. Laboratory measurements are required to indicate the effect of incremental dilution. The dilchill integrated operation should be investigated to confirm (1) The quality of waxes produced and their suitability in current formulations. (2) The yields of various melting point grades.

SIGNIFICANCE TO THE COMPANY

Increased production is required to supply a growing market.

FINANCIAL INCENTIVE

Incremental dilution may allow higher rates of production by reducing the refrigeration and recovery loads. Preliminary data from Baton Rouge tests indicate a 1¢/lb cost reduction. If a savings of 1¢ per lb could be made on Sarnia current production (23 MMLB) this would be $230 M. per year.

URGENCY

Work should be completed by 1973.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Wax

SOURCE: Marketing DATE January 1971

TITLE: Waxes for Miscellaneous Applications

CLASSIFICATION:

New Product or Process ------ Cost Reduction ----------

Improved Product or Process --X--- Exploratory Research -----

DEFINITION OF REQUIREMENT

Continued development work is required in many individual end uses of wax. Examples are customer service work which will be required in paper coating, rubber compounding, food coating, canvas coating, wax emulsions, candles, crayons, petrolatum, lamination wax blends and base for chewing gum. These products require special properties obtained by blending different types of waxes in many cases with low molecular weight resin or polymeric additives.

SIGNIFICANCE TO THE COMPANY

This work is required to maintain and increase Imperial's wax sales.

FINANCIAL INCENTIVE

Miscellaneous uses account for one-third of Imperials' refined wax sales. (i.e. 6 - 7 MM lbs).

URGENCY

Continuous action required.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Wax

SOURCE Marketing DATE January, 1971

TITLE Evaluation of Microcrystalline Waxes

CLASSIFICATION New Product or Process X Cost Reduction _____

Improved Product or Process _____ Exploratory Research _____

DEFINITION OF REQUIREMENT

There is a market in Canada for 5 mm lb of flexible laminating microwax. Imperial's wax is not suitable and imported basestocks are needed to manufacture waxes of the desired flexibility and adhesion.

Purchased microwaxes should be evaluated to determine their suitability in Imperial's formulations.

SIGNIFICANCE TO COMPANY

At the present time Imperial's sales of imported flexible microwax are negligible because they are higher in price than comparable Canadian manufactured products.

In keeping with the policy of manufacturing the most profitable base waxes, it is also desirable to consider discontinuing the manufacture of micro waxes at Sarnia and use the plant time released for the production of the lower melting point refined paraffin waxes.

FINANCIAL INCENTIVE

The economics of purchasing microwax for blending purposes and using the plant time previously used for making micros, to produce paraffin wax, should be determined.

URGENCY

Evaluation of purchased microwax will be required to be completed when feedstock for increased paraffin wax production becomes available from the new lube facilities.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Wax

SOURCE: Marketing DATE January 1971

TITLE: Wax Polymer Blends for Coating

(a) Corrugated Cardboard (Curtain Coating)

(b) Folding Cartons

(c) Flexible Packaging

CLASSIFICATION:

New Product or Process ---------- X ---------- Cost Reduction ----------

Improved Product or Process --------- X --------- Exploratory Research ----

DEFINITION OF REQUIREMENT

(a) Curtain Coating - Imperial's basic line of four Sealite wax - polymer blends is already available for curtain coating. These blends, covering a viscosity range up to 6000 SUS at 210°F, contain Elvax and other additives as required. Our line of wax blends will require improvements in following areas - lower cost, better gloss, higher friction and lower scuff.

(b) Folding Cartons - Cartons for frozen food, butter, margarine, etc., are coated on off-set gravures or roll-coaters. The coating should have high gloss with no blooming, low scuff, low MVTR and good grease resistance. These machines currently use products having viscosities up to 2000 SUS at 210°F. Research work is continuing on the development of products for the types of equipment now in the field. Heat sealable coatings with higher viscosities are required.

(c) Flexible Packaging - High speed packaging with flexible wrapping requires heat sealable coatings that have hot-tack, (i.e. seal strength when hot). Waxes containing large amounts of additives, including over 50% Elvax, are used for this application. Several products will have to be developed to cover the desired quality range.

SIGNIFICANCE TO COMPANY

The future market for hot melt blends in Canada will be dependent on the consumer acceptance of products coated with these materials. As acceptance has been slower than anticipated, the estimated market for 1975 is not as optimistic as before. Therefore, Imperial's estimated sales are correspondingly lower.

(a) Curtain Coating - At the present time there are 13 curtain coaters in Canada, with 2 more expected to be installed in 1971. Potential volume per coater is 1MM lbs/year as the demand for finished board develops. Competition now has a major share of this business and it will be necessary to continue to develop satisfactory products at competitive prices for Imperial to obtain its share. To facilitate this work Research has installed a laboratory Ashdee-Steinemann Curtain Coater.

(b) Folding Cartons - There are 17 carton coating machines now in operation with a current demand of approximately 1.5 MM pounds per year and a potential market of 3MM lbs. Imperial is currently supplying approximately 5% of this market.

(c) Flexible Packaging - Total industry demand is estimated at 500,000 lbs and this will rise to 1.2 MM lbs in 1972. Currently there are 6 machines for flexible packaging in Canada. Although several paper converters have their own blending equipment there is still a market for Imperial to share in, for finished blends. Until Sarnia has suitable equipment to manufacture high viscosity blends such products when developed will have to be custom blended.

FINANCIAL INCENTIVE

The following is Imperial's estimated sales and gross margin before taxes. The three classes have been combined since development work in one area will be applicable to the others.

	VOLUME M LBS	GROSS MARGIN
1972	1,900	$52,000
1975	3,200	$92,000

URGENCY -

Wax polymer blends are a fast growing segment of the wax market. It is essential that Imperial improve its position in the curtain coating field. Up-to-date information should be maintained on carton coating and flexible packages in the event that Imperial actively enters these markets.

RESEARCH REQUIRMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Wax DATE January 1971

SOURCE: Marketing

TITLE: Wax for Impregnating Corrugated Cardboard

CLASSIFICATION:

New Product or Process ----X---- Cost Reduction ----X----

Improved Product or Process --X---- Exploratory Research -------

DEFINITION OF REQUIREMENT

Two principle methods are used for treating corrugated cardboard with wax for production of rigid - when - wet corrugated containers.

(a) On the Corrugator - Wax is applied to the components on the corrugator with wax addition being from 10-20% by weight. Curtain coating may be used as a finishing treatment.

Paraffin wax (135/137) is being supplied to two plants of C.I.P. and Acme Paper for this use.

(b) Dipping or Flood Application - Finished boxes are impregnated by either dipping or flooding. Wax addition is 40-50% by weight. No finishing treatment is used.

Wax blends containing paraffin waxes and additives (resins and/or polyethylene) are used for this application.

The use of wax for treating corrugated cardboard is the most rapidly expanding segment of the wax industry in Canada. For both methods of application waxes which have improved wet-strength, lower cost and lower consumption will be required.

The mechanism by which wax protects paper fibres from wetting requires investigation.

SIGNIFICANCE TO COMPANY:

This work required to enable Imperial to obtain a major share of this rapidly growing market. The market for dip or flooding is expected to increase from 4.5 MM lbs. in 1970 to 10.0 MM in 1975. Volume for on-the-corrugator impregnation is expected to increase from 1.5 MM lbs. in 1970 to 8 MM lbs. in 1975. With satisfactory products our expected share is 9 MM for both applications.

FINANCIAL INCENTIVES:

The gross margin on Imperial's share (9 MM lbs.) will be $270,000.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

ASPHALT

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Asphalt

SOURCE Manufacturing DATE January, 1971

TITLE Manufacture of Asphalt Products

CLASSIFICATION

New Product or Process ..... X ..... Cost Reduction.....

Improved Product or Process ..... X ... Exploratory Research .....

DEFINITION OF REQUIREMENT

1. Evaluation of new crudes as discovered for their potential as asphalt sources.
2. Processing or product quality problems.
3. Product quality evaluations where experience or laboratory equipment is not available at a refinery.
4. Investigations of problems of mutual interest to several refineries.
5. Development of new products for special applications or at request of customers. Typical of these is the development of fire retardant asphalt for roofing applications.
6. Investigate asphalt manufacture by other processes.

SIGNIFICANCE TO COMPANY

Most of the Company's asphalt market is affected.

INCENTIVE

A large financial incentive but difficult to estimate in quantitative terms.

URGENCY

These are current problems. They are urgent as the need for a solution arises.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Asphalt

SOURCE Marketing DATE January, 1971

TITLE Improving the Low Temperature Performance of Very Soft Asphalt Cements from Light Western Canadian Crudes.

CLASSIFICATION

New Product or Process	X	Cost Reduction	
Improved Product or Process	X	Exploratory Research	

DEFINITION OF REQUIREMENT

The use of very soft asphalt cements is being adopted in Eastern British Columbia, the Prairie Provinces and Northern Ontario to minimize transverse cracking of asphalt pavements. The temperature susceptibility and ductility of these grades of asphalt made from Western Canadian light crudes will have to be improved by removal or modification of excess wax before they will be accepted for this application.

SIGNIFICANCE TO COMPANY

The entire asphalt cement requirements of Eastern British Columbia, the Prairie Provinces and N.W. Ontario could be involved. Currently Imperial can supply these grades on the Prairies and in Eastern B.C. only to the extent to which crudes yielding medium and high viscosity asphalts for blending are available to us. In Northern Ontario, we can supply out of Montreal, but with a penalty for any shipments west of the Lakehead.

INCENTIVE

Increase in profitability for Imperial's share of the market between the Ottawa Valley and the Pacific Coast if the need for running special crudes could be eliminated.

URGENCY

Research should be continued.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Asphalt

SOURCE Marketing DATE January, 1971

TITLE Investigate Low Temperature Properties of Asphalt Pavements.

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Resistance to transverse cracking depends upon the properties of the pavement at low temperatures. The effect of the asphalt cement, the composition of the mix, the structural composition and thickness of the pavement, the nature of the subgrade and the construction procedures on these properties must be determined.

SIGNIFICANCE TO COMPANY

The marketing of paving asphalts in the colder parts of Canada could be affected if major changes in grades of asphalt required are indicated.

INCENTIVE

A large financial incentive but difficult to estimate in quantitative terms. Basically, this incentive is the profitability of Imperial's share of the paving asphalt market in Eastern British Columbia, the Prairies, Northern Ontario, Quebec and Northern New Brunswick.

URGENCY

Research should be continued.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Asphalt

SOURCE Marketing DATE January, 1971

TITLE Investigate Essential Properties of Asphalt Paving Mixtures.

CLASSIFICATION New Product or Process ..... Cost Reduction.....

Improved Product or Process ..X... Exploratory Research .....

DEFINITION OF REQUIREMENT

Design and construction of better paving mixtures with special emphasis on the use of asphalts derived from light crude rather than from special crudes.

SIGNIFICANCE TO COMPANY

It is to the Company's advantage to be able to market asphalts obtained from crudes ordinarily run at our refineries, rather than from special crudes.

In addition we could lose much of the limited quantity of heavy crudes currently under our control that can be run specially for asphalt production.

INCENTIVE

Increase in profitability for Imperial's share of the market between the Ottawa Valley and the Pacific Coast if the need for running special crudes could be eliminated.

URGENCY

This is a continuing operation. It becomes urgent whenever a special need arises.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Asphalt

SOURCE Research DATE January, 1971

TITLE Investigation of Rheological Properties of Asphalts and their Applications.

CLASSIFICATION New Product or Process .....X..... Cost Reduction.....
Improved Product or Process ...X... Exploratory Research .....

DEFINITION OF REQUIREMENT

The performance of asphalt cements is directly related to their rheological properties and a better knowledge of these is required for proper appreciation of their capabilities and behaviour under various conditions.

SIGNIFICANCE TO COMPANY

All paving asphalts supplied by Imperial could be involved.

INCENTIVE

A large financial incentive but difficult to estimate in quantitative terms.

URGENCY

Research should be continued.

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

ADDITIVES

INDEX

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

ADDITIVES

I. BUSINESS TRENDS AND ASSESSMENTS

(a) Total Canadian Market (1970) - $ MM

The total Canadian market for additives is estimated below:

Additives for	Total Canada $ MM	% Consumed by Imperial
Lube Oils	17.0	45%
Middle Distillates	1.5	60%
Gasolines (excl. Lead)	3.5	50%
Total	22.0	47%

- Almost half the lube oil additive market is comprised of ashless dispersant, oil soluble sulphonates and zinc dithio phosphate.
- Flow improvers account for about 90% of the middle distillate additive.
- About 40% of the gasoline additive market is comprised of cryoscopic anti-stall additives such as glycols and carbitols.
- The total volume of this market is estimated at 12 million Imperial Gallons in 1970.

(b) Total Market Growth

The average growth in the value of the additives market is about 5% per year.

(c) Imperial's Market Share (1970) - $ MM

Additives for	Total Market	Consumed by Imperial	Supplied by Esso Chemical Canada to Imperial	to Others	to Export
Lube Oils	17.0	7.7	5.2	0.6	0
Middle Distillates	1.5	0.9	0.9	0.3	1.3
Gasolines (excl.Lead)	3.5	1.8	0.4	nil	0
Total:	22.0	10.4	6.5	0.9	1.3

It can be seen that Esso Chemical Canada supplied $7.4 MM of additives to the Canadian market in 1970. Esso Chemical plants manufacture $2.9 MM of this requirement, or 13% of the Canadian market (about $1.7 MM/year of lube and gasoline additive and $1.2 MM/year of middle distillate additive). In addition, $1.3 MM of Paradyne 20 was exported. Exports will fall sharply in 1971, when the European Flow Improver Plant will be in operation.

II. TECHNICAL TRENDS AND ASSESSMENTS

(a) Technical Trends

- changes in engine design and increases in auxiliary equipment will create a need for additives which have higher thermal stability and which increase oxidative stability of the oil. the same requirements will apply to automatic transmission fluid additives.
- need for lower ash in crankcase lubricants to meet specific sulphated ash limits and reduce H-C emissions.
- changes in engine design will require additives which will improve resistance to preignition induced by combustion chamber deposits.
- need to improve load-carrying properties of crankcase and two-cycle oils (especially in railway diesel oils for chrome-scuffing problems).
- more severe quality requirements resulting from new MS engine test targets and the requirements of Caterpillar Series IV and MIL-L-2104C.
- trend to multi-service lube products will continue. (e.g. Caterpillar Series III oil should be suitable for use in passenger cars).
- increased use of multi-grade lubricants creates need for low cost shearstable high-potency V.I. improvers. Low temperature fluidity requirements will become more severe.
- possible use of novel additional base stocks such as synthetic hydrocarbons, very high V.I. mineral oils (from severe hydrotreating), or esters.
- increased use of anti-friction bearings in industry,
- reduction of pollution will create technical changes in engine designs that could affect lubricant and fuel requirements. In gasoline this means progressive elimination of lead additives and reduction of exhaust emissions.
- increased use of turbine engines.
- tar sands extraction processes may require process aids.

(b) New Markets for Additives

- ashless crankcase additives.
- additives which contribute less to preignition.
- additives which reduce intake valve deposits.
- vapour phase rust inhibitors for lube oils.
- additives to increase bearing metal fatigue life in anti-friction bearings.
- increased potential for low cost high potency shear stable V.I. improvers in industrial and gear oils.
- wax additives.
- process aids.
- increased use of sludge dispersant additives for gasoline.
- replace chemicals such as TEL and hexylene glycol with other additives.
- anti-haze additives for middle distillates.

III. IMPLICATIONS AND CONCLUSIONS

(a) Technical changes and innovations are occurring rapidly, but development time of new products is lengthy. Research must look ahead several years.

(b) Basic manufacture of additives is required in order to realize significant additive profits. This increases Imperial's need for continued additive process research.

(c) In lube oil additives we will require ingredients which contribute less to preignition and ash deposits than those currently used as alkalinity donors and anti-wear agents. Ashless components will be required to fulfill these functions. Higher thermal stability will be important.

(d) Should continue to recognize the need to minimize the number of additives in order to reduce the complexity of the handling and blending operations.

(e) Close liaison with automotive equipment manufacturers is mandatory so that optimum additive packages can be developed for new requirements ahead of demand. This will allow more efficient reformulations of crankcase lubes and lower cost additive systems. In addition, this activity should create improved acceptance of our additive systems by the equipment manufacturers.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Research Department DATE: January 1971

TITLE - Improved Wax Crystal Modifiers for Middle Distillate Fuels.

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process X Exploratory Research _____

DEFINITION OF REQUIREMENT

A continued research effort is required to maintain Jersey's technical leadership in this field. Wax crystal modifiers should be improved to allow the use of broad range of fuels at lower temperatures than at present. The test methods to evaluate filter plugging by wax should be improved. If possible an additive to depress the cloud point should be developed.

SIGNIFICANCE TO THE COMPANY

Furnace oil used in outside tanks and diesel fuel are low cloud point products during the winter. Wider boiling range blends are acceptable and sometimes preferred, if the problems with wax crystals could be overcome. Thus, higher yields of middle distillates could be achieved.

The forecast high demand for turbo fuel tends to create a need for more extensive use of flow improvers in middle distillates. This trend is counter-balanced by increased gasoline to middle distillate ratio and hydrocracker capacity e.g. Sarnia Refinery. Improved quality will be required to treat effectively a broader range of fuels, especially fuels of high straight-run content.

INCENTIVE

The use of flow improvers allows large savings in the cost of fuel products. This situation is expected to continue.

On railway diesel in Eastern Canada alone a 5°F reduction in cloud point is worth $100-$200 M/year.

URGENCY

Can be utilized immediately.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group DATE: January 1971

TITLE - Improved Additive Packages for Motor Oils, HD Oils and Transmission Fluids.

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process	X	Exploratory Research	

DEFINITION OF REQUIREMENT

Due to the rapidly changing quality targets of motor and heavy duty oils, there is a continuing need for updating both additive packages as well as the individual ingredients which make up the packages. The detailed requirements are difficult to forecast, but past experience indicated that a major effort will be required each year for the foreseeable future. Examples of this type of work are:

(1) Additive packages for Uniflo and other service station oils to achieve improved quality with zero ash by 1974.
(2) Additives to provide superior performance for diesel and heavy duty gasoline engines in fleet service.
(3) Improved additive packages for Caterpillar Series 3 or Series 4 oils.
(4) Improved additive packages for railway diesel lubricants.
(5) Ashless additive packages for stationary gas engine oils.
(6) Lube additive package to reduce corrosive wear in engines which burn intermediate and residual fuels.
(7) Additive packages for advanced automatic transmissions.

Future trend will be toward lower ash requirements. For automobile oils these packages must allow formulation of oils with improved low temperature fluidity. The effectiveness of these additives should be checked in conventional and high (130+)VI basestocks where applicable.

SIGNIFICANCE TO THE COMPANY

Proprietary additive packages lead to improved quality, lower corporate costs and market leadership.

INCENTIVE

Imperial's annual expenditure for additive packages of this type is over $5MM. Research is required to enable the company to maintain its leadership in lube oil markets and to lower the corporate costs.

URGENCY

Improvement in this technology is a continuing requirement.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group DATE: January 1971

TITLE - Improved Components for Formulating Crankcase Oils and Transmission Fluids.

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process	X	Exploratory Research	

DEFINITION OF REQUIREMENT

Additive packages for motor and heavy duty oils are blended from individual additive components which in turn may be classified under one of the following:

(1) Detergent/Dispersants.
(2) Rust/Corrosive Wear Inhibitors
(3) Anti-scuff/Anti-oxidants

Of these three classes the last two are dominated by metal containing additive ingredients such as, metal sulphonates, phenates, phosphonates and di-thiophosphates. Only the first group includes both ashless and ash containing additives.

In order to remain competitive it is necessary on a continuing basis to develop new and more economical components (both ash containing and ashless) for each of the three types. The need is particularly apparent in the case of rust/corrosive wear inhibitors where we rely on outside purchases for our requirements.

There is also an increasing demand for low ash or ashless additive packages. These in turn require ashless components. Among the detergent/dispersants there are a large number of ashless materials available but a continuing research effort to develop new components is nevertheless, required to remain competitive. The last two classes of components have seen the development of several ashless candidates but these have only made small headway against ash containing components. Further research here could pay off handsomely.

SIGNIFICANCE TO THE COMPANY

A vigourous research and development program on additive components is required to remain competitive in both cost and product quality.

INCENTIVE

Imperial annually spends over $5MM for additive packages based on components described above. Any break-through in the form of a new component with a better performance/cost ratio could materially increase profits.

URGENCY

A continuing requirement.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group DATE: January 1971

TITLE - Viscosity Index Improvers.

CLASSIFICATION

New Product or Process _____ Cost Reduction X

Improved Product or Process _____ Exploratory Research _____

DEFINITION OF REQUIREMENT

V.I. improvers are required to formulate modern multi-grade motor and heavy duty oils. The trend is towards additives having exceptionally good viscosity retention properties in service (low breakdown), combined with low thickening properties at 0°F. New VI improvers must have minimum adverse effect on intake valve deposit formation and diesel engine performance. The objective is to provide multigrade oils, eg. 10W 40, which are equivalent in high temperature performance to a monograde oil, such as SAE 30 or 40. Continued research is required to improve existing products and develop new ones.

SIGNIFICANCE TO THE COMPANY

V.I. improvers will be required for motor oils in the foreseeable future and will gain in use and importance.

INCENTIVE

This work is important to maintain leading position in lube oil markets. Superior V.I. improvers may be the most economical way to provide further advanced lubricants relative to high V.I. basestocks or synthetic lubricants.

URGENCY

Improvement in this technology is a continuing requirement.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group DATE: January 1971

TITLE - Dewaxing Filter Aids.

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process X Exploratory Research _____

DEFINITION OF REQUIREMENT

An effective filter aid for 30 and 60 grade oil is needed to increase the throughput of product at the Dewaxing Plant.

SIGNIFICANCE TO THE COMPANY

Dewaxing capacity limits the production of base oils at Sarnia.

INCENTIVE

$175,000/year after tax based on increased throughput at Sarnia for 30 grade. Calculation assumed equivalent improvement to that obtained using Paradyne 20 in 5 grade. This incentive would decrease in the period following startup of the new Sarnia lube plant in 1973.

URGENCY

Can be utilized immediately.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group DATE: January 1971

TITLE - Gasoline Additives

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process	X	Exploratory Research	X

DEFINITION OF REQUIREMENT

New or improved gasoline additives should be developed to reduce exhaust emissions or to reduce any undesirable side effects of these engine modifications made to meet pollution regulations.

More effective gasoline additive packages to reduce total engine deposits and intake valve deposits in particular would be desirable as would improved control of engine wear and rusting. The application to Imperial gasolines of additives to improve fuel-air mixture distribution in the engine should be investigated. Development of a safe, low cost anti-stall additive package should continue.

SIGNIFICANCE TO THE COMPANY

Proprietary additives with demonstrable benefits afford a better opportunity to attract and keep customers than new developments in processing technology which are generally available to all refiners.

INCENTIVE

Effective additives could increase sales and reduce the risk of drastic changes to gasoline composition to control vehicle emissions.

URGENCY

Competitive activity is high and early leadership in this field would be beneficial to sales.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group DATE: January 1971.

TITLE - New or Improved Additive Packages for Diesel and Heavy Fuels.

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process	X	Exploratory Research	

DEFINITION OF REQUIREMENT

There is a need for continued effort on the development of additive packages for fuels. Examples of currently required packages are:

(1) Injector anti-foulant for diesel engines.
(2) Smoke suppressant, stabilizer and exhaust deodorant for premium diesel fuels.

SIGNIFICANCE TO THE COMPANY

Continued research and development is required to allow prompt and efficient commercialization of these new quality features in fuels.

INCENTIVE

Continued research and development is required to increase the company's participation in this growing market and thereby lower Imperial's corporate cost.

URGENCY

New additive packages of this type will continue to be required.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Research Department DATE: January 1971

TITLE - Carbon Scavenger Additives

CLASSIFICATION

New Product or Process	X	Cost Reduction	
Improved Product or Process		Exploratory Research	X

DEFINITION OF REQUIREMENT

Detergents and oxidation inhibitors in paraffin oils have been found to reduce their carbon deposition properties to levels equivalent to naphthenic oils. Efforts up to now have been directed towards increasing the thermal stability of paraffinic oils. A different approach is suggested. Experiments should be made to find catalysts or agents able to promote at high temperatures the thermal decomposition of mineral oils into volatile components, and thus eliminate carbon formation.

SIGNIFICANCE TO THE COMPANY

Synthetic hydrocarbon oils (polybutylene and α -olefin oils) are known to decompose without leaving carbon hebind. Additives able to achieve the same results with mineral oils would help to hold in check the inroads in the mineral oil market of synthetic hydrocarbon oils.

INCENTIVE

Not assessed.

URGENCY

Carbon scavengers could be utilized when available.

RESEARCH REQUIREMENTS

PLANNING GROUP - Additives

SOURCE - Planning Group. DATE: January 1971

TITLE - New Additive Technology for Industrial Oils.

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process X Exploratory Research _____

DEFINITION OF REQUIREMENT

Development of additives for the following is needed -

1. Additives to replace lead and eliminate lead pollution hazard.
2. Additives to replace sulphurized sperm oil which may become unavailable during 1971.
3. Additives to replace sulphurized mineral oil giving equivalent or better E.P. and A.W. properties. Our sulphurizing plant pollutes with H_2S and we have a 1972 deadline to overcome this.
4. Better additives and blending procedures to improve foaming and air entrainment properties.
5. A rust inhibitor that is compatible with ZDDP.
6. Vapour phase inhibitor additive for circulating oils.

SIGNIFICANCE TO COMPANY

1, 2, and 3 - Necessary to comply with environmental conservation requirements.

4, 5 and 6 - Necessary to match or improve on competitive quality.

INCENTIVE

Protect our present market for the major portion of our industrial oils and greases.

URGENCY

2 and 4 - Required by 1971

1, 3, 5 and 6 - Required by 1972.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Home Products

SOURCE: Marketing - Home Products Division DATE: January 1971

TITLE: General Research and Development Requirements

CLASSIFICATION:

New Products or Process	X	Cost Reduction	
Improved Product or Process	X	Exploratory Research	

DEFINITION OF REQUIREMENTS:

In 1971 Research assistance is required in the following areas in order to maintain and expand sales of Esso-brand consumer packaged goods:

1. Miscellaneous analytical, development and service work to include:

   - reformulation of existing products when required to satisfy consumer demands and maintain quality image and leadership,
   - laboratory analysis of competitive products,
   - evaluation of new or modified packages,
   - laboratory service work for licensed manufacturers,
   - development of formulae for new products requiring little or no background investigation and evaluating established Esso formulae in light of Canadian conditions, laws, or consumer needs.

2. Advice on New Product Opportunities

   Recognizing and recommending new ideas for products based on newly acquired data from Esso Research, patent searches, technical journals, etc., is a most important function of the Research Department and can provide an invaluable source of product ideas at very low cost or time involvement.

3. Short-Term Studies

   Research priority should be centred on short-term studies in support of:

   - pesticide extensions to the Flit line of weed and bug killers.
   - personal and area repellant extensions to the Flit line.

Activities would include:

- screening ideas for technical practicality,
- feasibility studies to determine if chances of success are high and research costs warranted,
- investigation and search of patents and literature,
- projects requiring limited manpower.

4. Long-Range Studies

In the second half of the year there may be a specific requirement to determine product feasibility of new household cleaners and air-fresheners emerging from current consumer concept testing, employing outside specialist research facilities when necessary.

SIGNIFICANCE TO THE COMPANY

Only through a planned research effort can we profitably expand in the consumer field of marketing and establish a consumer franchise in line with long-range plans.

FINANCIAL INCENTIVES

Without specifically identifying projects, return on research investment cannot be calculated. The current scale of effort does indicate, however, that research investments in the league of $5M will maintain an annual new product revenue increment of approximately $150M, as well as product standard work on existing products with a value of $1.5MM.

URGENCY

Due to the volatile nature of the consumer market, we must be prepared to start work on short notice and program to complete in short spans of time.


ENVIRONMENTAL
PROTECTION

IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

ENVIRONMENTAL PROTECTION

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IMPERIAL OIL LIMITED

RESEARCH REQUIREMENTS

ENVIRONMENTAL PROTECTION

LEGISLATIVE TRENDS, PUBLIC ATTITUDES AND ASSESSMENTS

Public concern regarding environmental problems is being translated into legislation rapidly. Increasing attention is being directed to garbage and solid waste disposal. The movement to recycle wastes is growing and is being presented as a challenge to the packaging and container industry. Domestic sewage remains as one of the principal water pollution problems across the country but it is politically more expedient to focus attention in other areas. Major incidents in 1970, such as the "Arrow" and the mercury level found in fish in the Great Lakes and other waterways, have served to maintain the momentum of environmental awareness. Air pollution indexes in Toronto and Montreal and the cutbacks which have been ordered in a number of instances have similarly kept air pollution in the forefront.

The present trend in legislation will require substantial expenditures to reduce emissions and waste discharge from all facilities and reduce the impact on the environment of the products we sell.

- The Canada Water Act was passed giving the federal government broad powers in water resource and quality management.

- The federal government formed the Department of Environment and Renewable Resources to draw together the scattered responsibilities for air and water pollution. The old Fisheries and Forests Department will be the core of the new department. Serious problems could arise if the previous attitude of Fisheries prevails and the concern for fish becomes the dominant factor in environmental and particularly water quality management.

- The federal government has taken over regulation of auto emissions under the Automobile Safety Act. It appears that federal jurisdiction will be exercised over the manufacture and sale and the provinces will provide the enforcement of the cars on the road. The regulations are very similar to those in the U.S. and are likely to continue to follow this pattern and could include restrictions on gasoline composition and additives.

- As promised during the Arrow disaster, the federal government has promulgated tough new regulations under the Canada Shipping Act. The most disturbing aspects are the establishment of a fund to pay damages and provide for clean up of any oil pollution to be funded by a levy of up to 15 cents per ton on all marine oil cargoes and the holding of the cargo owner jointly and severally liable with the ship owner for any damage resulting from an accident. The oil industry environmental association, PACE, is sponsoring a brief to the Commons Environmental Committee which is holding hearings on the amendments to the act.

- The varied positions of members of the oil industry on lead-free gasoline have created a complete state of confusion in the public mind on this subject.

- The Waste Control Act 1970 was enacted in Ontario dealing with the disposal of solid and liquid wastes. The disposal of used crank case and industrial oils is becoming a problem in most locations.

- The Petroleum Association for the Conservation of the Canadian Environment (PACE) has been formed by the major oil companies in Canada to provide a means to approach common industry problems of environmental affairs.

- Regulations have been issued for the Metropolitan Toronto and Montreal areas which reduce the sulphur content of fuel oils in stages to 1973.

- Development of the Federal Oil Spill Contingency plan by the inter-departmental committee is proceeding very slowly. An interim plan has been written by the Ministry of Transport but it has not been distributed outside of government circles as yet.

- The Arctic Land Use regulations have been drafted and are expected to be announced in the near future.

- Obtaining new sites for plant locations will be a serious problem.

Technical Trends and Assessments

Air Pollution

1. The development of reliable criteria for ambient air quality is badly needed to define acceptable quantitative levels for pollutants.

2. Control of smoke, dust and odour is becoming more important. This requires emphasis on clean burning products and clean operating equipment.

3. The requirement for lower sulphur content fuel oils will likely spread as more monitoring stations are set up and air pollution index data becomes available.

4. Hydrocarbon conservation and emission control will almost certainly be extended to bulk plants and ultimately also to service stations.

Water Pollution

1. Concern over eutrophication of the lower Great Lakes will bring about tough regulations (e.g. federal government ban on phosphates in detergents by 1972) which will undoubtedly require at least secondary treatment of refinery effluents.

2. Sizeable efforts will be required to minimize water use, improve oil and water separation and improve processes for the removal of very low concentrations of pollutants in waste water effluents.

3. All facets of oil spill clean-up technology need improvement. The art of containment and removal of oil from fast-flowing streams is primitive at best. The economic incentive is to reduce the extremely high costs of clean-up by present methods. If better ways are not found to clean up oil spills, and thereby substantially reduce the effect on the environment, regulations or outright bans could be imposed which would interfere with our present flexibility of oil movement.

Liquid and Solid Wastes

1. Pressure will increase to find ways of recycling materials currently considered to be waste. Conservation of natural resources and the environment will jointly act as the driving forces. There are developments in Europe, particularly in France, which are attracting attention along these lines.

Community Noise Levels

1. Up to the present time noise problems have been quite specific, flare noise being the principal cause for complaint. Increasing attention will be required to reduce noise levels in the community. NRC have suggested noise level standards which would appear to be almost impossible to meet.

Arctic

Report of the Government Task Force on the Mackenzie Delta was generally favourable to industry concern about, and efforts in, the Arctic. With the scale of development foreseen for the Arctic, continuing efforts will be required to conduct that development in a manner which protects the environment.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP Environmental Protection

SOURCE Environmental Protection Coordinator DATE December 18, 1970

TITLE Oil Spill Clean-up Technology

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process		Exploratory Research	X

DEFINITION OF REQUIREMENT

Oil spill clean-up technology is deficient in many areas; existing equipment and procedures are marginally effective under severe circumstances. Industry and government research is under way in many countries to try to improve this situation. The large scale research effort can best be handled by this approach.

However, there is a need for a modest capability of our own to evaluate the technology, products, etc. as they emerge, in terms of Imperial's specific requirements - for example, a rough screening of adsorbents.

SIGNIFICANCE TO THE COMPANY

As new techniques and materials become available, some assessment of their worth must be made before an intelligent decision can be made with respect to their usefulness to Imperial. Currently these are being performed independently in many locations across the country. A central evaluation capability would avoid the costly duplication and produce more consistent and meaningful results.

In our position in the Industry we must have some activity in this area if we are to fulfil our obligation of responsibility to the community.

FINANCIAL INCENTIVE

As part of our Oil Spill Contingency Plan, Imperial will be purchasing sizable quantities of equipment and materials to combat oil spills. It is mandatory that these funds be spent as wisely as possible.

The clean-up of oil spills is extremely expensive, anything which would improve our capability could substantially reduce this cost.

URGENCY

Any new information or evaluations could be used immediately.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Environmental Protection

SOURCE: Producing DATE November 10, 1970

TITLE: Oil Spills in the Arctic

CLASSIFICATION: New Product or Process ---------- Cost Reduction -----

Improved Product or Process ------ Exploratory Research ----- X

DEFINITION OF REQUIREMENT

With our increased emphasis on oil exploration in the Arctic there is the potential for major oil spills. Very little is known of the effect of very low temperatures on the rate of natural degradation of oil by bacterial action.

Various methods should be investigated to combat and clean-up a major oil spill in the Arctic by bacterial action, chemical methods (polymerization?) or controlled burning.

SIGNIFICANCE TO COMPANY

It would be most important, particularly from a Public Relations standpoint, if Imperial would instigate this type of research.

FINANCIAL INCENTIVE

Without the proper oil spill clean-up procedures there is always a possibility that public opinion, influenced by Environmentalists, will force a slowdown if not a complete stop of oil exploration in the Arctic.

URGENCY

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Environmental Protection

SOURCE: Producing DATE November 10, 1970

TITLE: Oil Spill Clean-up in Heavy Seas

CLASSIFICATION: New Product or Process ---------- Cost Reduction -----

Improved Product or Process ------ Exploratory Research ----- X

DEFINITION OF REQUIREMENT

Next year Imperial Oil and Amoco will resume drilling on the Grand Banks. Procedures for oil spills are covered by the Jersey Oil Spill Cleanup Manual. However, the problem of oil spills during severe sea conditions in the North Atlantic, are far from solved. More and more equipment for the containment and clean-up of oil spills is appearing on the market and this equipment should be tested and appraised for the severe sea conditons in the Grand Banks Area.

SIGNIFICANCE TO COMPANY

From a Public Relations stand point it would be significant if Imperial Oil would instigate this kind of testing.

FINANCIAL INCENTIVE

In the case of a major oil spill without the proper corrective measures public opinion could conceivably force curtailment of oil exploration in the area.

URGENCY

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Environmental Protection

SOURCE: Producing DATE November 10, 1970

TITLE: Smoke-free Waste Oil Burner

CLASSIFICATION: New Product or Process ---------- Cost Reduction ----- X

Improved Product or Process ------ Exploratory Research -----

DEFINITION OF REQUIREMENT

The Alberta Oil and Gas Conservation Board prohibits burning of waste oil in the field unless such burning can be done without causing smoke.

A smoke-free burner will have to be developed which is portable and can burn crude oil as well as tank bottoms and waxes removed from flowlines.

SIGNIFICANCE TO COMPANY

In our production operations in Alberta an estimated 2000 to 3000 Barrels per year of waste oil (wax etc) has to be disposed of by burning. Present burning frequencies are estimated at 200 - 225 a year.

The alternative to burning is trucking the oil to the nearest battery or refinery for reprocessing.

FINANCIAL INCENTIVE

The estimated cost of disposing of the oil instead of burning varies from $3 to $10 per barrel.

A well-designed burner would be readily accepted by other oil producers faced with the same problems.

URGENCY

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP: Environmental Protection

SOURCE: Marine Division DATE: November 19, 1970.

TITLE: Anti-pollution measures in ice-infested waters.

CLASSIFICATION: New Product or Process----------Cost Reduction--------

Improved Product or Process-------Exploratory Research---X---

DEFINITION OF REQUIREMENT

Ability to minmize the effects of oil pollution in ice-infested waters.

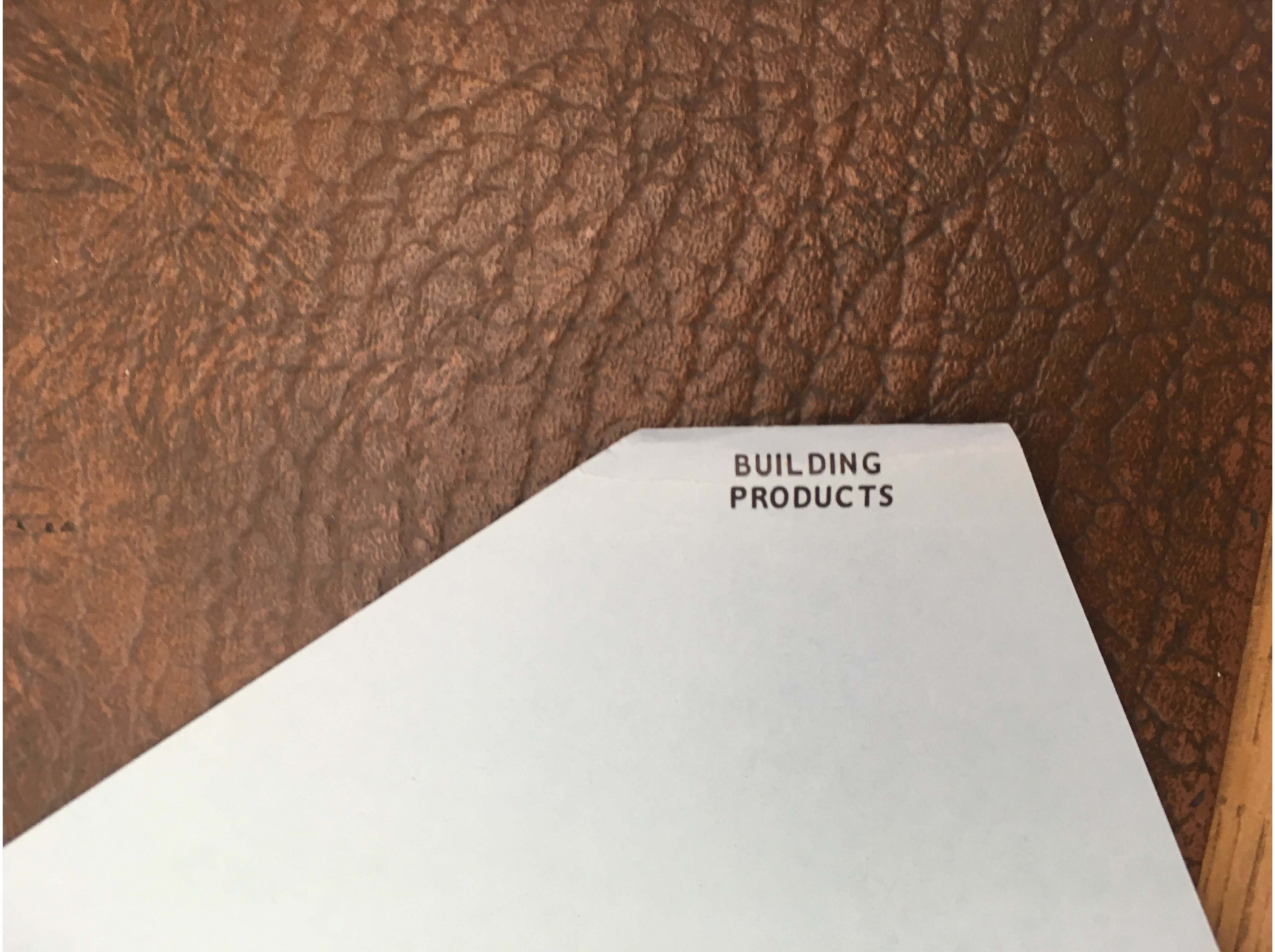
SIGNIFICANCE TO COMPANY

Safeguard its public image.

FINANCIAL INCENTIVE

Indeterminate

URGENCY As soon as possible


BUILDING
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BUILDING PRODUCTS OF CANADA LIMITED

RESEARCH REQUIREMENTS

PREAMBLE

A. Business Trends and Assessments

Building construction in the long term will be strong with industry spending in the residential sector averaging 5.5% growth to 1975. New housing starts reached an all time high in 1969, 214,000 units, and are expected to move strongly into the 1970's reaching 250,000 units by 1975. The strong trend towards high rise apartment construction has peaked earlier than forecast. Because of growing sociological problems, more emphasis will be placed on low rise, high density dwellings; that is low level apartment buildings and row housing.

The operating environment has changed in several important aspects over the last year. BPOC is no longer divisionalized on the basis of product lines; Building Materials, Plastics and Flooring. It is now organized on a functional basis with Marketing, Production and Financial Divisions. A new department, Commercial Development, has been formed to bring together the various skills, resources and drive required to improve BPOC's competitive position. Research and Development Department is a part of Commercial Development.

BPOC is in the process of developing a three year plan, the planning base has already been outlined in presentations to Esso Chemical Inc., and detailed economics and programs are being developed now for presentation to Esso in February 1971. The long term company objectives have been defined as:

- To achieve a 17% cash generation ratio on current and future investments;
- To maintain present market position in our major product lines;
- To broaden our base in the construction industry.

B. Technical Trends and Assessments

The residential construction industry is in a state of transition in many parts of Canada. By 1975 we estimate that as many as 20,000 single family units, 5,000-10,000 semi-detached and row houses, and 15,000 apartment units will be made largely from site assembled components or sections. Several different approaches are being pursued; Alcan for instance - factory built houses which are transported to the site in two sections,

placed on prepared foundation and finished in two days. System home builders in Montreal manufacture panel systems which are transported to the site and erected on a prepared foundation in one week.

There is also a significant trend towards maintenance free exterior finishing materials. Thus there has been a significant growth in the products satisfying this market. Aluminum has, to date, made the largest gains, but in the U.S.A. the use of PVC building materials is growing at 30% per year. This rate is expected to continue through 1975.

There is a strong requirement for increased fire ratings on our products. Work is being carried out which will assist us in developing more fire resistant materials for both the roofing and fiberboard markets.

C. Implications and Conclusions

The 1971 Research Requirements have again been evolved as in past years after discussions with the operating personnel. Most of the projects are of a short term nature, but some of them at least will have, we believe, a long term impact upon our Company. Thus we start work this year for the first time on plastic building materials. Our efforts will be directed towards firstly, establishing performance criteria for plastics in building and secondly, reducing the cost of making our products. Several very promising ways of reducing the cost of producing, for example, vinyl siding have been identified and they will be thoroughly explored in the next year.

The phenolic foam project takes us into a whole new technology with a product which will, we believe, give us a significant advantage with the increasing awareness throughout the building industry of the need for materials with good resistance to fire and fire damageability. This technology will also take us into new markets, notably the wall insulator market for non-residential buildings.

The work of the Fibres Group will, this year, continue along the lines established in the last few years. We are, however, becoming more involved in the planning and design phases of the proposed new board mill.

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC

DATE November 25, 1970

SOURCE Research and Development

TITLE Asphalt Emulsion

CLASSIFICATION

New Product or Process	X	Cost Reduction	X
Improved Product or Process		Exploratory Research	

DEFINITION OF REQUIREMENT

To complete the transfer of emulsion making technology to the plant production of fibrated roof coating emulsion.

To develop manufacturing formulae for other asphalt emulsion products.

SIGNIFICANCE TO THE COMPANY

BPOC has been manufacturing asphalt emulsions for almost three years. The product line is to be widened by adding a roofing coating emulsion, both for cold process roofing and for the proposed two ply factory emulsion coated roofing process. Presently BPOC purchases this type of emulsion.

FINANCIAL INCENTIVE

Marginal incomes for conventional cold process roofing using BP manufactured emulsion will increase by an average of $118 M per year over the next ten years. Increases of ~ $400 M per year are expected from sales of two ply factory emulsion coated sheets over and above those from sales of four ply or two ply Super 40 roofing in the same period. These increases are only attainable by use of a BP manufactured emulsion. A DCF of 57% is indicated.

URGENCY

Immediate

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC DATE November 25, 1970

SOURCE Marketing Division

TITLE Fire Retardant Woodfibre Products

CLASSIFICATION

New Product or Process ____ Cost Reduction ____

Improved Product or Process X Exploratory Research ____

DEFINITION OF REQUIREMENT

The building codes are steadily becoming more stringent in respect to the flammability of building materials. There is, therefore, a need for products having either a lower flame spread rating or having lower overall combustibility.

Previously derived methods of attaining fire retardancy will now be implemented to produce "fire hazard" type products which Underwriters' Laboratory label for code acceptance.

SIGNIFICANCE TO THE COMPANY

BPOC has a considerable and well established market in flammable woodfibre products, and this is vulnerable to the above changes. Knowledge of methods of imparting fire retardance or fire resistance will significantly reduce this vulnerability.

FINANCIAL INCENTIVE

Retain present business and be in a better position to expand our market.

Initial implementation of woodfibre "fire hazard" products in place of mineral fibre products in 1971 would show a profitability of ~ $150 M.

URGENCY

Immediate

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC DATE November 25, 1970

SOURCE Commercial Development

TITLE Phenolic Foam

CLASSIFICATION

New Product or Process X Cost Reduction

Improved Product or Process Exploratory Research

DEFINITION OF REQUIREMENT

Continuing development work is required to take the phenolic foam project from the laboratory to the semi-works stage.

SIGNIFICANCE TO THE COMPANY

We have identified two markets for phenolic foam:

(1) Roofing insulation

(2) Wall insulation

BPOC is now a major supplier of woodfibre roof insulation.

Roof insulation is, however, expected to lose a significant share of the market over the next ten years. The properties/price relationships for phenolic foam and its potential competitors - perlite, woodfibre, glassfibre and polystyrene have been studied and in our view we will be able to retain our market position with phenolic foam.

FINANCIAL INCENTIVE

After four months of study, a task force recommended that we build a semi-works plant in 1971, $300 M, and a production unit (1972/73) on the basis of a 22.3% DCF.

URGENCY

Immediate

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC DATE November 25, 1970

SOURCE Marketing Division

TITLE Plastic Profiles

CLASSIFICATION

New Product or Process X Cost Reduction

Improved Product or Process Exploratory Research

DEFINITION OF REQUIREMENT

BPOC is currently producing PVC siding. Extension of the product line to include other exterior cladding materials, PVC soffit and fascia, vertical siding, and PVC window frames is a requirement of the Marketing group.

SIGNIFICANCE TO THE COMPANY

Widening the product line will enable us to market a maintenance free exterior cladding system. This is essential to allow us to compete effectively with the aluminum cladding systems now on the market.

FINANCIAL INCENTIVE

Preliminary studies indicate that the additional marginal income from the addition of these products to the line will reach $700 M by 1973.

URGENCY

Immediate

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC DATE November 25, 1970

SOURCE Research and Development

TITLE PVC Siding

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process ____x____ Exploratory Research ____

DEFINITION OF REQUIREMENT

A program is required to (a) increase our understanding of the product performance criteria, (b) investigate several alternative ways of improving our technology.

SIGNIFICANCE TO THE COMPANY

The U.S. market has grown at some 30% per year over the last five years. A similar growth rate is forecast in Canada. BPOC is the only Canadian manufacturer, and we must ensure that our product design and technology are superior to that of our potential competitors.

FINANCIAL INCENTIVE

It is estimated that cost savings of at least $1.0 MM can be achieved by 1973.

URGENCY

Immediate

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC DATE November 25, 1970

SOURCE Marketing Division

TITLE Woodfibre Products

CLASSIFICATION

New Product or Process ____ Cost Reduction X

Improved Product or Process X Exploratory Research ____

DEFINITION OF REQUIREMENT

To investigate the current BP woodfibre product manufacturing processes, identify areas of appreciable cost savings and to work out the technology necessary to achieve them. Further to keep Management fully acquainted with all new technology relative to woodfibre product manufacture for incorporation within present or future manufacturing facilities.

SIGNIFICANCE TO THE COMPANY

In order to remain fully competitive and use production facilities to their highest degree of profitability, BP must continually update its technology, particularly in the area of using cheaper raw materials such as wood wastes.

A definitive study of the fibreboard products market has shown that Canadian industry can support one additional fibreboard mill. Of the Canadian companies BP is best placed to accept this opportunity as it has the greatest ability to reorient or relocate production.

FINANCIAL INCENTIVE

Cost savings of at least $128 M have been identified.

URGENCY

Immediate

RESEARCH REQUIREMENTS

PLANNING GROUP BPOC DATE November 25, 1970

SOURCE Marketing Division

TITLE Two Ply Roofing

CLASSIFICATION

New Product or Process X Cost Reduction

Improved Product or Process Exploratory Research

DEFINITION OF REQUIREMENT

To complete the development and implement commercialization of a two ply roofing system characterized by a factory applied weathering surface of asphalt emulsion.

SIGNIFICANCE TO THE COMPANY

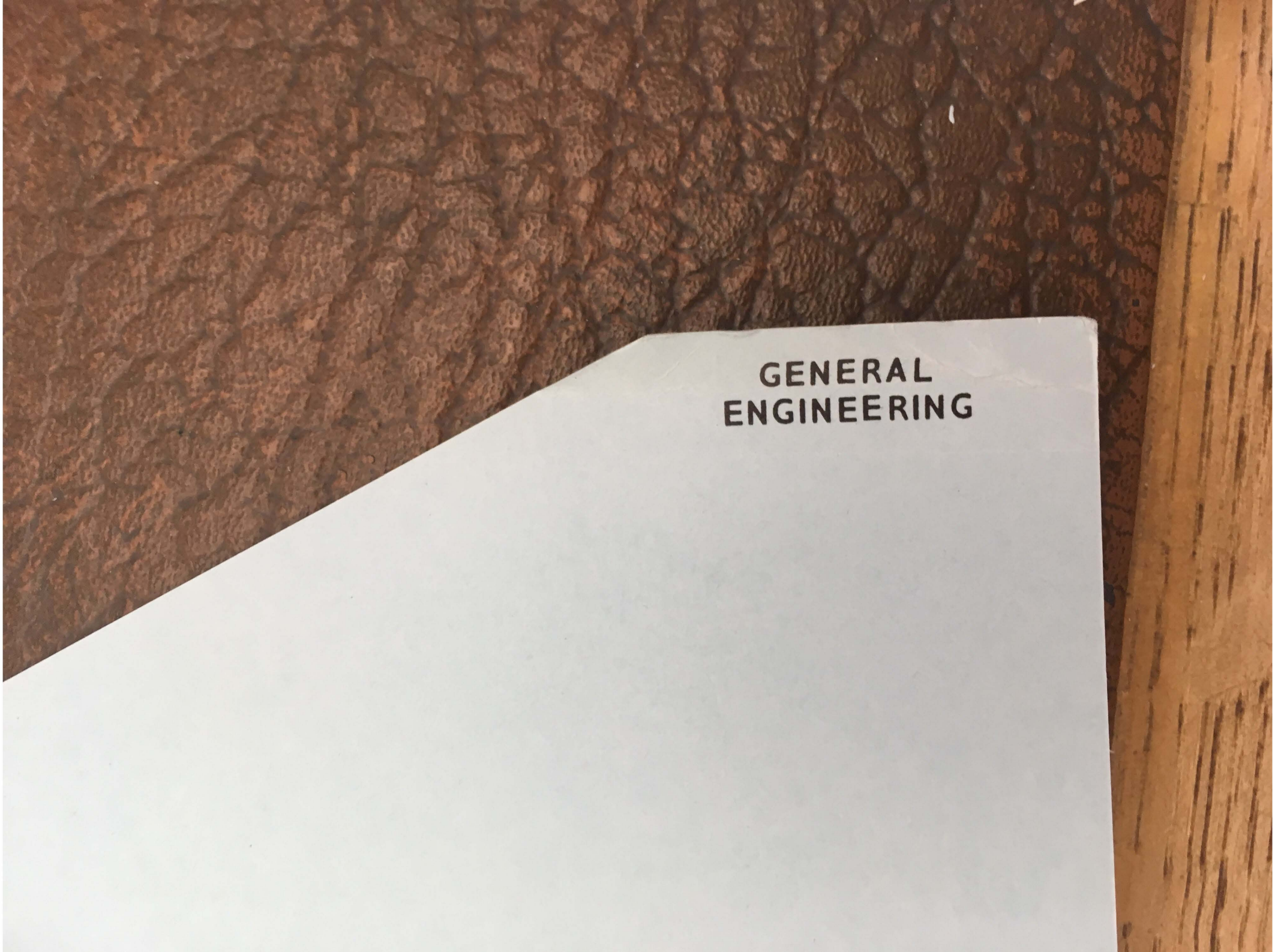
The sale of asphalt impregnated and coated roofing felts generates considerably more marginal income per square than the sale of the more normal saturated felts. This development of a two ply system of roofing based on coated felts and a patented factory applied asphalt emulsion weathering surface could give BP a unique position in a portion of the roofing market.

FINANCIAL INCENTIVE

A recent economic survey has shown that over a period of ten years, the marginal income for this system will increase by an average of $400 M over that from sales of conventional four ply or two ply Super 40 roofing over the same period. A 26% DCF is indicated.

URGENCY

Immediate


GENERAL
ENGINEERING

IMPERIAL OIL LIMITED

GENERAL ENGINEERING R & D PROGRAM

INDEX

GENERAL ENGINEERING R & D PROGRAM

INDEX - Continued

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

GENERAL ENGINEERING RESEARCH AND DEVELOPMENT

CODE 500

PREAMBLE

SUMMARY

This review is concerned with the General Engineering Research and Development program. The current business environment in Canada has resulted in our refineries having increases in their costs and margins dropping. This has influenced the proposed program to emphasize needs in the areas of improving existing petroleum processing such as Catalytic Cracking, Powerforming, Gas Treating, and Heavy Oil Distillation. Other areas that might improve margins or reduce costs are in the use of materials of construction and the use of new computer control techniques. The future needs of meeting gasoline quality without the use of T. E. L. suggest improvements in blending techniques and processes to provide proper blending stocks.

The protection of the environment and reduction of possible pollutants to an absolute minimum from processing equipment will require new technology. Imperial's suggested program is related to these general areas.

In addition to the detailed summaries included there is a list of "title only" type problems that currently are causing concern. Further analysis of these problems will be made before definitive projects are suggested.

Along with the programs suggested, Imperial strongly supports a wide range of General Engineering R. and D. projects which are under way by Esso Engineering and are published in their Report No. EE. 9LD. 70 dated June, 1970. Probably over 80% of their program will have application to Imperial and their program is highlighted as follows:

A. Engineering Improvement of Existing Petroleum Processes

The periodic updating of the designs of important fuels processes are covered in this R & D area. The present program includes four projects with two applying to Cat.

Cracking and one each to Gas Treating and Powerformers. The design studies are needed so that latest technology can be incorporated, changing yield patterns accommodated, and pollution-control problems minimized.

B. Chemical Engineering Technology

The four principal areas marked for attention are thermodynamic data, fractionation, reactor design and fluid transport and phase separations. The knowledge generated will form the starting point for process design, plant performance analysis and operating improvement studies.

C. Process Control-Systems Engineering

Work is aimed at the development of improved methods, and equipment, for control of Jersey's manufacturing operations. The applications of digital-process-control computers, and onstream process analyzers, are believed to have yielded significant returns. The program is geared to expanding the applications.

D. Equipment Evaluation and Development

The program in this category is concerned with the evaluation, or development, of new types of major equipment for use in Jersey's manufacturing plants. Work is to continue in the areas of (1) Furnaces, Burners, Heat Exchangers, (2) Pressure Vessels and Piping, and (3) evaluating instruments and techniques for the onstream monitoring of machinery condition.

E. Materials Engineering

There is a large incentive to improve Jersey's ability to select economic construction materials, reduce corrosion, and to use improved (or new) techniques for welding and inspecting materials. Effort is programmed for all these areas.

F. Civil, Industrial and Utilities Engineering

Work is programmed to develop improved technology for, (1) evaluating and improving land sites, (2) designing foundations, structures and buildings, (3) establishing and evaluating

F. Civil, Industrial and Utilities Engineering (Cont'd)

safety and fire-protection requirements and (4) designing and optimizing utilities and materials-handling systems. A high degree of operability and reliability are necessary in the areas mentioned to insure that process operations are not jeopardized.

G. Engineering Mathematics

Investigation is planned on the potential use of the spline-function curve-fitting technique for solving, at lower computer cost, models of stagewise processes and tubular reactors.

H. Environmental Control

A very major effort is programmed for this category to assure compatibility of new plant designs, and locations, and products, vis-a-vis environmental-control considerations. The total projected effort cuts across several of the R & D program categories. For easy reference, all items are summarized on one sheet in the assembly of program items accompanying this preamble. Work is planned in the following areas:

a) 1980 Pollution-Free Refinery Design
b) Water Conservation
c) Air Conservation
d) Waste Disposal, Noise Control, Pollution Monitoring

I. Terminalling R & D Program

The planned program has the objectives of reducing capital and operating costs of terminalling facilities such as piers, offshore moorings and storage facilities. Much of the technology developed will not be of direct interest to Imperial in the short range, but there are bound to be longer-term benefits.

J. Fire Protection and Safety

New fire-fighting equipment, and industry experiences with fires, will contined to be evaluated. Technological improvements, and lessons learned, will be passed along to us.

K. Manuals and Services

A part of the tool-making effort of Esso Engineering involves the development and maintenance of about 10 manuals, such as Basic Practices, Design Practices, Cost Estimating, etc. This is a continuing and very necessary endeavour. Engineering Services projects involve such things as a Library of Process Applications for Computer Control, a Valve Application Manual, and User's Guide to Machinery-Vibration Analysis, etc.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Improvements in Cat. Cracking Technology

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process	X	Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

1. Develop unit design and configurations to optimize the use of zeolite catalysts in existing and new units.
2. Define conditions for maximum naphtha and middle distillate yields through combinations of hydrotreating and cat. cracking.
3. Develop techniques for optimizing octane recovery by selective naphtha fractionation.
4. Improve technology in catalyst regeneration, catalyst attrition and entrainment, and riser cracking.
5. Define equipment required to meet anti-pollution regulations.

SIGNIFICANCE TO THE COMPANY

The recent development and widespread use of zeolite catalyst introduces new factors in design concepts for cat. cracking units. There is considerable economic incentive to develop these concepts in order to optimize the operation of Imperial's eight existing units, as well as projected future installations.

Definition is required of conditions to produce optimum yields of naphtha and middle distillates from combinations of hydrotreating and catalytic cracking. This should include knowledge of the results of hydrotreating either fresh feed

SIGNIFICANCE TO THE COMPANY - continued

or recycle, and the effects not only on yields but on product qualities. Techniques for optimum recovery of octanes by selective fractionation of cat. cracked naphthas will be important in the determination of equipment to meet future lead-free gasoline requirements.

Technology improvements are required to upgrade catalyst regeneration efficiency of Imperial's cat. cracking units. This will involve regenerator operations up to 1250°F and carbon-on-regenerated-catalyst levels of 0.1% or lower. Further development of techniques for applying the concept of riser cracking, by physical modifications to our units, is also required.

Compliance with anti-pollution regulations will require the development of techniques for reducing solids emissions by improvement in both catalyst recovery equipment and unit operations. Further reductions in emissions of solids and noxious gases such as H_2S and CO will require definition of existing or new pollution abatement equipment.

FINANCIAL INCENTIVE

1. A 1% increase in naphtha yield is worth $500,000/year.

2. A 10% reduction in catalyst costs is worth $300,000/year.

3. A 0.1% reduction in carbon-on-regenerated-catalyst is worth $100,000/year.

URGENCY

The continuing importance of cat. cracking in a lead-free environment gives a high priority to improvements in technology of the process.

Pressures imposed by anti-pollution legislation, existing or proposed, make early developments in this field essential.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Powerforming

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process	X	Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

1. Develop improved process equipment and operating methods to improve reliability and reduce operating costs. These should include flow distribution and vapour/solid contacting devices.

2. Define any problems in the associated aromatics extraction process.

SIGNIFICANCE TO THE COMPANY

Current reforming operating problems are related to low service factor which is affected primarily by:

a) Poor hydrofiner reliability (insufficient equipment)

b) Regeneration equipment failure.

Secondary considerations include:

a) Corrosion
b) Furnace and compressor operation
c) Reactor shroud design.

FINANCIAL INCENTIVE

Imperial's expenditures for future powerforming capacity in the seventies will approximate $50 MM. Improved reliability will reduce the investment by reducing the stream-day capacity needed in a given case.

Future refining throughput will be tied closely to hydrogen availability.

URGENCY

High, due to the increased significance of reforming in a lead-free environment.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Hydrocracking

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process	X	Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

1. Continue with the program to improve metallurgical technology of thick walled vessels.

2. Improve design criteria for high pressure equipment.

SIGNIFICANCE TO THE COMPANY

Imperial's first hydrocracker (11,000 B/SD) is being brought on stream at Sarnia Refinery one year behind schedule due to major equipment problems. Serious product supply implications and costs have resulted from the delay.

A second hydrocracker of about 13 MB/SD is indicated as a possibility by 1975 in Edmonton expansion studies. Design and necessity for this unit will be determined, in part, by future jet fuel market trends.

FINANCIAL INCENTIVE

A capital expenditure of $20 MM at Edmonton in the 1975-78 period is a possibility.

URGENCY

Imperial assigns a low priority to work in this field, at this time.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Alkylation

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process	X	Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

1. Improve the design of the following equipment used in HF alkylation units.

   a) Acid Regenerator
   b) HF Stripper
   c) Fractionation towers with HF in the feed

2. Develop or select improved materials for use in alkylation units.

   a) Valve packing and grease
   b) Instrument components
   c) Pressure vessel materials and linings
   d) Pump seals

3. Develop methods and equipment for the safe and efficient disposal of acidic or neutralized wastes from Alkylation units.

SIGNIFICANCE TO THE COMPANY

1. High acid losses are due in large part to poor regeneration. Poor fractionation results in loss of isobutane. Inefficient acid stripping leads to higher treating costs and downstream corrosion problems.

SIGNIFICANCE TO THE COMPANY - continued

2. New materials for instrumenting, pump seals, etc. would eliminate high maintenance costs.

3. Waste disposal is a major cost, particularly with H_2SO_4 alkylation.

FINANCIAL INCENTIVE

1. Reduction in HF acid losses could be significant. A 65% reduction is considered possible with a resultant saving of $65,000/year on existing units.

2. Reduction of high maintenance costs.

URGENCY

Alkylation produces a high octane gasoline component and will be a highly desirable product in a lead-free environment.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Blue Book Physical Properties

CLASSIFICATION

New Product or Process _____ Cost Reduction _____

Improved Product or Process _____ Exploratory Research _____

Improved Technology X

DEFINITION OF REQUIREMENT

Hydrocarbon physical properties such as octane number, aniline point, freezing point, pour point and cloud point should be included in the Blue Book. Blending methods for these properties should also be included.

SIGNIFICANCE TO THE COMPANY

While approximations are available from various Jersey publications, and new data frequently appear, it is felt that this data most properly belongs in the Blue Book. The principal benefit would be the use of reliable data by all Jersey affiliates.

FINANCIAL INCENTIVE

In the design of new facilities it is very important that specification qualities be correctly predicted. For instance, an over-prediction of octane could require costly quality support, or possibly additional units.

URGENCY

Moderate.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Octane Blending Calculation Procedure

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process		Exploratory Research	
		Improved Technology	

DEFINITION OF REQUIREMENT

For the lead-free-mogas environment, accurate calculation procedures are required for octane blending. For leaded gasolines octane adjustments are relatively simple and inexpensive due to the lead-flywheel effect. Quality giveaway in lead-free gasolines will result in exhorbitant costs as large volumes of expensive high-octane aromatics would be required. The various paper blending procedures currently available are not consistent, particularly in predicting the higher clear-octane levels. Further development of these calculation procedures is warranted to provide a more precise blending tool incorporating the interrelations between volatility and octane. They will also serve to point up the hardware required for mogas blending in the future.

SIGNIFICANCE TO THE COMPANY

Aromatics will replace lead as the octane flywheel in the lead-free-gasoline environment. Large volumes of aromatics will be required to effect small octane adjustments in a given blend. However, this can not be done indiscriminantly without, at the same time, recognizing the effect on volatility. Quality giveaway must be minimized as the aromatics are costly and available in limited quantities.

FINANCIAL INCENTIVE

Precise blending-calculation procedures will minimize reblending or quality giveaway, and permit more realistic assessments of future blending facilities. The nature of the blending facilities will be of much greater significance in the lead-free environment.

URGENCY

Imperial has already started marketing low lead Esso 2000. Although Imperial is not planning to market a lead-free gasoline until the fourth quarter of 1974, competition (Shell) may force this timing to be advanced.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Adsorption Technology

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process	X	Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

Exploratory effort is needed to develop and determine the effectiveness of adsorbents (e.g., molecular sieves) for removing undesirable components from naphthas and light distillates. Mercaptans and water are examples of undesirable components. Particular attention should be given to regeneration techniques and mercaptan number of products.

Insufficient data are now available for the design of molecular-sieve-adsorption units. Suppliers of molecular sieves provide adsorption data for static (equilibrium) conditions for a variety of single components. However, the suppliers use dynamic (non-equilibrium) data for single and multiple components in their design proposals. The dynamic-condition data are not made available to customers. Dynamic data for single and multiple adsorptions are required for design and operation of molecular-sieve units.

SIGNIFICANCE TO THE COMPANY

Qualitative information indicates a molecular-sieve-type adsorbent (or other adsorbent structure) might perform in one step what now requires a conversion process (e.g., Merox) plus a drying operation. A saleable mercaptan product might be obtained by a suitable adsorption technique. Caustic (and sour-water) disposal problems might be eliminated. Clay treaters to remove surfactants from jet fuels might also be eliminated.

Molecular sieves are successfully used at Imperial's Ioco Refinery for removal of mercaptan sulphur, H_2S and water from LPG. The facility was a packaged vendor design and required a number of post-startup modifications. If basic data were available, Jersey would have control over the design of such molecular-sieve installations instead of being dependent on supplier's technology.

FINANCIAL INCENTIVE

Preliminary studies have shown that molecular sieves are competitive with other drying processes when haze specifications are stringent. An adsorbent process for removal of any, or all, of mercaptans, surfactants and water could be very attractive.

Procurement of molecular sieves and molecular-sieve installations could be put on a more competitive basis. Designs must now be obtained from suppliers of the molecular sieves. When patents expire on molecular sieves in 3-5 years, it may not be possible to take advantage of possible lower prices from an augmented group of suppliers, if we do not have in-house basic design information.

URGENCY

Early developments in this field could result in immediate commercial exploitation.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Update Packed-Tower Section of Design Practices Manual

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process		Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

The Packed-Tower section of the Design Practices Manual should be brought up to date with the current technology and strictly maintained. The updating would include:

1. A revision of the Generalized Pressure-Drop Correlation or an improved pressure drop and flooding correlation.

2. A more realistic HETP correlation for packing for hydrocarbon systems (especially for Pall Rings).

3. Guidelines concerning the choice of packed-tower internals - including relative spacing within a tower.

As a temporary measure, general instructions concerning use of the FRI Handbook, and the validity of its correlations, should be made available.

SIGNIFICANCE TO THE COMPANY

Future refinery-capacity requirements will dictate that process equipment be debottlenecked to its maximum capacity. Packings provide distillation-tower capacity greater than the capacity of conventional trays. Packings are just beginning to be used, and the frequency of installations is increasing rapidly. It is essential that our design methods be updated to take full advantage of packed towers.

FINANCIAL INCENTIVE

The monetary incentive will be very marked where expansions can be realized with existing towers and packing, as the alternative to new towers. Use of packing in vacuum pipe-stills, light ends towers, etc., will also permit a significant reduction in demand for capital where new fractionators are required.

URGENCY

Updated technology can be applied as soon as it is available.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Update Technology Used to Design Atmospheric Heavy-Hydrocarbon Systems

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process		Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

This project was originally proposed by E.R.& E. for their 1970 research program and subsequently deferred. The steam-stripped system-activity correction presented in Report No. EE.12.ER.65 (The Design of Heavy Hydrocarbon Fractionation Systems) was based on bubble-cap-trayed towers and should be checked for other fractionation internals. The project expects to update the ASPECT and COPE tower-computer programs and obtain better basic data for dissimilar-composition systems -- such as steam cracking primary fractionators.

The project should also investigate reboiled stripping in the area of atmospheric heavy-hydrocarbon fractionation systems. A significant reduction in refinery sour-water volume can be achieved by eliminating steam stripping.

SIGNIFICANCE TO THE COMPANY

Imperial operates fourteen atmospheric pipestills, eight cat. fractionators and one steam-cracking fractionator -- most of which limit the capacity of the respective units. The improved correlations proposed would permit a more precise definition of fractionation capacity.

FINANCIAL INCENTIVE

Over the next ten years Imperial expects to build, every second year, approximately a 75 MB/SD atmospheric pipestill and a 20 MB/SD cat. fractionator. Improved methods for

FINANCIAL INCENTIVE - continued

predicting heavy-hydrocarbon stripping and fractionation could save in the order of 5% of the investment for the above facilities by permitting better processing arrangements.

URGENCY

Required by 1974.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Heat Losses from Storage Tanks

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process		Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

A reliable method, preferably computerized, is required to calculate heat losses from storage vessels in services ranging from LPG to residua to asphalts.

The existing computer programs (770 and 1605) predict heat losses of only 1/3 to 1/2 of those calculated by hand computations using the most recent formulae and procedures recommended by E.R. & E.

SIGNIFICANCE TO THE COMPANY

Apart from the time involved in hand calculations, no firm data are available to support the validity of the results. Invalid answers can result in improperly-sized heaters, or inefficient insulation practices, which can cause monetary loss as well as processing or O.M. & S. problems.

FINANCIAL INCENTIVE

The magnitude cannot be defined with any certainty. A capital outlay in the order of $65,000 is required to provide 2" of insulation for a 150' x 48' tank.

The Sarnia Lube Project required hand calculations of insulation requirements for 60 tanks.

URGENCY

Could find immediate and continuing use.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Addition to Design Practices

CLASSIFICATION

New Product or Process ____ Cost Reduction ____

Improved Product or Process ____ Exploratory Research ____

Improved Technology X

DEFINITION OF REQUIREMENT

Prepare a new section of Esso Design Practices which would be used for consolidated Control Room projects and/or Computer Control projects. This section should include sub-sections on such items as Control Building Requirements and layout, Process Operators Consoles, Specific Computer requirements, the relationship between number of inputs and number of computers, etc.

SIGNIFICANCE TO THE COMPANY

Introduce standard design procedure to a part of technology now in wide application in Jersey and for which no standard presently exists.

FINANCIAL INCENTIVE

Impossible to assess, but since many different design approaches and criteria are being used, it must be presumed that some are wrong and are causing losses.

URGENCY

Immediate need.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Methods of Inspection of Heat Exchanger Bundles

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process		Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

A more definitive means of inspecting exchanger bundles is required in order to increase our inspection confidence level and ability to predict replacements. Any technique must allow for inspection of tubes at the centre of the bundle.

SIGNIFICANCE TO THE COMPANY

Improved inspection techniques in this area will:

- decrease the frequency of in-service tube failures, and
- help increase run lengths.

FINANCIAL INCENTIVE

Indeterminate.

URGENCY

Moderate to high.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Inhibitor to Mitigate High Temperature Sulphur Corrosion

CLASSIFICATION

New Product or Process	X	Cost Reduction	
Improved Product or Process		Exploratory Research	X
		Improved Technology	

DEFINITION OF REQUIREMENT

An inhibitor which would effectively prevent, or reduce corrosion due to sulphur in hydrocarbon streams at temperatures above 550°F.

SIGNIFICANCE TO THE COMPANY

Imperial experiences high temperature sulphur corrosion in many units -- including crude pipestills, hydrofiners and cat. cracking units. Prevention or reduction of the corrosion by sulphur could:

1. Reduce the cost of planned maintenance.
2. Improve service factor by decreasing unscheduled shutdowns.
3. Increase unit capacity by decreasing pressure-drop problems resulting from fouling with corrosion products.
4. Reduce the amount of alloy required in new units.

FINANCIAL INCENTIVE

Unscheduled shutdowns of crude pipestills continue to occur. For example, in the last quarter of 1970, the Ioco crude unit was off stream for 36 hours because of a failure of a reduced-crude line. The Calgary crude unit was cut back 25%, for 48 hours, in the last quarter of 1970, because of a transfer-line failure. On the Sarnia A & V unit and Fluid Coker the processing of 650 B/D of one high-mercaptan-content crude results in maintenance costs of about $100,000 per year. Reliability of

FINANCIAL INCENTIVE - continued

existing hydrofiner-preheat unit equipment could be improved by a reduction in corrosion rates and this would lead to improved heat transfer and less reactor plugging.

URGENCY

Early developments in this field could result in immediate commercial exploitation.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Inhibitor to Mitigate Corrosion in Cat. Cracking and Coker Light Ends Units

CLASSIFICATION

New Product or Process	X	Cost Reduction	
Improved Product or Process		Exploratory Research	X
		Improved Technology	

DEFINITION OF REQUIREMENT

An inhibitor is required to reduce corrosion in the alkaline-aqueous environments (pH 7-9) found in Cat. Cracker and Fluid Coker Light Ends units.

SIGNIFICANCE TO THE COMPANY

In Imperial's Cat. Cracking units, onstream failures -- particularly of heat exchanger tubing -- occur in a random manner despite the use of water washing and/or injection of film-forming-amine inhibitors. Failures occur from NH_3-H_2S-H_2O attack in the presence of cyanides.

Water washing is a partially effective method of combatting this corrosion. The development of an effective inhibitor would:

a) Permit existing equipment to be operated with fewer unscheduled downtime periods for repairs.

b) Reduce the volume of sour water coming from cat. light ends units by reducing the volume of wash water required.

FINANCIAL INCENTIVE

Not available. Onstream failures of cat. light ends equipment continue to occur in most refineries. Short shutdowns are necessary to make temporary repairs. Sour water disposal is

FINANCIAL INCENTIVE - continued

becoming more of a problem and any reduction in volume of cat. sour water could reduce future outlay of capital.

URGENCY

Early developments in this field could find immediate commercial exploitation.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Development of a High Temperature Alloy with Improved Carburization Resistance

CLASSIFICATION

New Product or Process	X	Cost Reduction	
Improved Product or Process		Exploratory Research	X
		Improved Technology	

DEFINITION OF REQUIREMENT

Select from commercially available alloys, or develop a new alloy, which would have considerably improved carburization resistance in Ethylene-Pyrolysis-Furnace service.

SIGNIFICANCE TO THE COMPANY

Maintenance on the Sarnia Gas Cracker Furnaces is high, due to a high incidence of tube failures. Failures are largely due to carburization and creep. The use of an alloy with improved carburization resistance would greatly improve tube life, service factor of furnaces, and reduce maintenance costs.

FINANCIAL INCENTIVE

On the four Sarnia furnaces, the estimated direct maintenance cost in 1970 is $225,000. Unit downtime, which can be attributed to furnace-tube problems, has been estimated at a further $164,000. Improved material would be installed on a scheduled basis as and when tube replacements were required.

URGENCY

High.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Mitigation of Corrosion in Powerformer-Effluent Circuits

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process	X	Exploratory Research	X
		Improved Technology	

DEFINITION OF REQUIREMENT

Determine conditions under which corrosion occurs in powerformer-effluent circuits. An understanding of the conditions could make possible the application of economic preventive measures.

SIGNIFICANCE TO THE COMPANY

Severe corrosion has been found in the November - December, 1970 period in the powerformer-effluent circuits at Sarnia and Dartmouth. Inspection data indicates that corrosion rates have accelerated within the past year or two.

FINANCIAL INCENTIVE

Condenser-tube failures lead to an unscheduled shutdown of #1 Powerformer at Sarnia in late November, 1970. One condenser bundle required retubing, together with repairs to the condenser shell. Replacement tubes for all six bundles have been ordered.

One effluent-condenser bundle at the Dartmouth Powerformer required immediate retubing during the December, 1970 shutdown. The second bundle is to be retubed early in 1971.

URGENCY

Would find immediate application. Service factor on our powerformers is becoming increasingly critical.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Materials of Construction for Sour Water Strippers

CLASSIFICATION

New Product or Process ____ Cost Reduction ____

Improved Product or Process ____ Exploratory Research ____

Improved Technology X

DEFINITION OF REQUIREMENT

1. To develop a better understanding of the materials of construction which can be used successfully in the steam stripping of any or all of the following:

   a) Crude unit desalter brine
   b) Crude pipestill overhead water (containing chlorides)
   c) Cat. Cracker sour water
   d) Hydrofiner sour water.

2. Materials suitable for stripper overhead airfin condenser tubing with a design life of 10 to 15 years.

SIGNIFICANCE TO THE COMPANY

Imperial has operated several steam sour water strippers at Montreal but has experienced severe corrosion in several areas. Aluminum has been used successfully for overhead equipment, but cannot be used on units where chlorides and/or caustic could be anticipated.

Information from Benicia, and other non-company sources, indicates a severe lack of knowledge as to materials which will give extended service lives on critical equipment.

FINANCIAL INCENTIVE

Reliable operation of sour water strippers will become increasingly critical. Improved technology could:

a) increase reliability;
b) decrease unnecessary capital requirement (possible savings $100,000 per unit).

URGENCY

Immediate. We anticipate being able to use new technology as soon as it is available.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Metallurgical Technology for Application of Weld Overlay Deposits on Low Alloy Steel Pressure Vessels

CLASSIFICATION

New Product or Process		Cost Reduction	
Improved Product or Process	X	Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

1. To increase technical knowledge of factors affecting the quality of high alloy weld overlay deposits, particularly when applied to low alloy steel base metals requiring post weld heat treatment.

2. To develop a more satisfactory method of assessing fabricator's overlay welding procedures.

SIGNIFICANCE TO THE COMPANY

Imperial has experienced severe cracking in Austenitic stainless steel weld overlay deposits in exchangers being fabricated for the Sarnia Conversion Project, and in vessels which had been in service in the Montreal Methanol Unit.

During the repairs to the Sarnia vessels, further overlay cracking was experienced in all three fabrication shops involved. Delays were experienced in qualifying welding procedures.

During the next five years and beyond, weld overlay vessels will be required by the Company. A better understanding of the critical welding parameters needed to produce crack free overlays would reduce the possibility of delays in the fabrication of new equipment, and would assist in the selection of competent fabricators.

FINANCIAL INCENTIVE

The cost of repairs to weld overlay deposits is extremely high and could result in very expensive delay in startup date of processing facilities.

URGENCY

Imperial would anticipate being able to use the technology as soon as it is developed.

ENVIRONMENTAL CONTROL PROJECTS IN ESSO ENGINEERING'S PROPOSED 1971 PROGRAM FOR GENERAL ENGINEERING RESEARCH AND DEVELOPMENT *

		CODE
	GENERAL POLLUTION CONTROL	
**1.	1980 Pollution-Free Refinery Design	537
2.	Instrumentation for Pollution Control	537
3.	Develop and Evaluate Noise Data and Attenuation Devices	537
4.	Solid and Liquid Waste Disposal	537
	WATER CONSERVATION	
5.	Waste-water Reuse Techniques	537
6.	Improved Removal of Free Oil and Solids from Water	537
7.	Improved BIOX Operation on Refinery and Petrochemical Streams	537
8.	Removal of Dissolved Impurities from Liquid Effluents	537
9.	Non-Toxic Corrosion Inhibitor - Recirculating Cooling Water Systems	534
10.	Thermodynamic Data for Process Water Contaminant and Pollution Control	531
11.	Water Quality Management Program	593
	AIR CONSERVATION	
12.	Air Pollution Abatement	537
13.	Catalytic Cracking to Meet 1972 Air Pollution Requirements	512
14.	Particulate/Gas Separation Fundamentals and Applications	537

AIR CONSERVATION - continued

		CODE
15.	Low NOx Emission Combustion	533
**16.	Develop Low-Noise, Non-Luminous Flare System	537
17.	Air Quality Management Program	593

* The projects on these pages are listed from Table 2 on Page 6 of Report No. EE.9LD.70, dated June, 1970. Imperial supports the proposed environmental control program for extension into 1972, and at this time does not have any major areas not covered by the program.

** The two items identified are scheduled to terminate in 1971.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Equipment Spacing Requirements Interpretation

CLASSIFICATION

New Product or Process		Cost Reduction	X
Improved Product or Process		Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

Interpretation of Design Practices equipment spacing guides is needed. Explanation required as to how the spacing guides were determined and to what extent, if any, deviations are permissible.

SIGNIFICANCE TO THE COMPANY

Proper spacing is vital for safety reasons and has a considerable influence on unit construction and maintenance costs.

FINANCIAL INCENTIVE

Indeterminate.

URGENCY

Immediate.

RESEARCH REQUIREMENTS - IMPERIAL OIL LIMITED

PLANNING GROUP General Engineering R & D

SOURCE Logistics DATE December, 1970

TITLE Reduction in Safety-Valve Discharges

CLASSIFICATION

New product or Process		Cost Reduction	
Improved Product or Process		Exploratory Research	
		Improved Technology	X

DEFINITION OF REQUIREMENT

Safety relief valve discharges become more hazardous and contribute more towards pollution with: (a) capacities of refineries increasing, (b) refineries near populated areas, (c) new types of operations, and (d) new legislation. Less hazardous discharge systems are necessary. Consider elevated stacks with steam purge; water quench systems; tower heat source cut off; extra pressure rating on equipment to eliminate safety relief valves; parallel safety relief valves with pressure controls which release to closed system before safety relief valve lifts; etc.

SIGNIFICANCE TO THE COMPANY

Reduces: (a) the possibility of a serious fire or catastrophe and (b) pollution by Logistics Department.

FINANCIAL INCENTIVE

Indeterminate.

URGENCY

Immediate.

TITLE-ONLY PROJECTS

1. Fluid-Coker Entrainment

2. Phenol-Tray Design

3. Process Technology for Alkylation and Isomerization

4. Dilution-Chilling Design Correlations

5. Re-evaluation of Charpy Testing Requirements