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MEMORANDUM

INVESTMENT AND OPERATING COST FOR

- a) Fischer Pilot Unit Studies at Baton Rouge
- b) Synthesis Gas Regenerator Studies at Baton Rouge.

On September 25, 26, and 27, Mr. Roberts of the Kellogg Co. and the writer met with various representatives of the Development and Research Laboratory at Baton Rouge to present ideas on the requirements for a study of the Fischer Process and to discuss the investment and operating cost involved in such a study at Baton Rouge. The Baton Rouge people had previously been supplied with a preliminary layout of a Fischer pilot unit having a production capacity of 5 B/D of synthesis product and this layout was largely used in the discussions pertaining to the synthesis plant proper. In addition it was desired to get the development and research ideas on the probable expense involved in making preliminary studies of the production of synthesis gas by make and blow regenerators as contemplated in the economic studies of the process.

A. FISCHER PILOT UNIT

The Fischer Pilot Unit was set up on the basis of producing synthesis gas by means of the single large scale tube experimental reforming furnace available at Baton Rouge. Since a rather large supply of CO₂ is necessary it was assumed that this could be obtained from the Baton Rouge Hydro Plant by providing a line together with the necessary compressor, cooler and separating drums. This point was discussed with Dr. L. E. Miller and he saw no reason why a suitable arrangement could not be worked out to supply the gas in this way.

With regard to the use of the reformer furnace itself, apparently there is a possibility of using this equipment for other studies. It was felt, however, that even if decision were made to go ahead with the Fischer study a considerable period of time would be available for conducting other experimental work using this furnace.

The preliminary layout of the pilot unit contemplated an oil scrubbing recovery system. Since that time Mr. Roberts has obtained costs on providing an alumina drying and ammonia refrigeration system to extract the hydrocarbons from the gases leaving the plant. This arrangement appears to be more direct and possibly much simpler in operation and the investment costs of the plant were set up on this basis. We feel, however, that Baton Rouge should give additional consideration to the various methods outlined and indicate any preferences they have from an operating standpoint since the investments involved are probably not very different.

The possibility of utilizing existing equipment at Baton Rouge was also reviewed and it was agreed that it would be useless to count on obtaining any equipment in this way. Therefore the investment was set up on the basis of obtaining all new equipment.

A possible site for the pilot unit seems to be in the area adjacent and north of the building which formerly housed the experimental hydrogen furnaces. This area will require some clearing. However, some consideration has been given to utilizing this area for the methanation work. A second choice for the Fischer unit site was not developed.

The following tabulation shows the estimated investment cost for providing a 3 B/D pilot unit operable at both low and high synthesis pressures.

Investment Cost for 3 B/D Fischer Synthesis
Pilot Unit

1.	Install 2" line for CO ₂ - 2500 ft.	\$1250
2.	<u>Compressors</u>	
	a) 30 GPM; 25 PSI for CO ₂	1200
	b) 150 " 150 " " Syn. Gas	4000
	c) 150 " 5 " " " "	1000
3.	<u>Instruments and Automatic Controls</u>	4000
4.	<u>Pumps</u>	
	a) Reactor feed water, 50 G.P.H.; 300 PSI	
	b) Oil trans. 50 " ; 10 "	400
5.	<u>Heat Exchange Surface (Ex Recovery Plant)</u>	
	a) Mist extractor cooler 40 sq.ft. steel	
	b) Reformer raw gas " 50 " "	
	c) Reactor products " 20 " KA ₂	
	d) Reactor Steam " 15 " steel	800
6.	<u>Drums</u>	1000
7.	<u>Fischer Reactor</u>	1250
	a) Steel work	500
	b) Insulation and heat control	500
	c) Shipping	100
8.	<u>Alumina Driers</u>	500
9.	<u>Refrigeration System</u> 1.5 tons, -65°F.	3500
10.	<u>Site Clearance</u>	1000
11.	<u>Building</u> 20 x 30 ft.	1500
12.	<u>Holder</u> 1000 CF	1000
	Sub Total	\$23500
	<u>Erection</u>	14500
	<u>Engineering & contingency</u>	5000
	Sub Total	\$43000
	<u>Allowance for additional reactors</u>	5000
	<u>Allowance for Ruhrchemie catalyst</u>	2000
	<u>total</u>	\$50000

With allowances for Ruhrochemie catalyst, together with the possibility of experimenting with other reactors a total investment cost of \$50,000 was reached after also allowing \$14,500 for erection and a \$5000 contingency. Baton Rouge estimates on the cost of erection were as high as \$10,000 and it is felt that because of the preliminary nature of the project some additional allowance should be made and the figures indicated above are felt to represent a reasonably good estimate of the probable investment cost which might be incurred.

Operating cost for the synthesis pilot are outlined in the following. In the setup it is assumed that essentially no labor charges will be incurred in operating the CO₂ compressor at the Baton Rouge Hydro Plant since this machine will be set up to be as automatic as possible. Operation of the pilot unit was estimated to require three operators per shift. Allowances for technical supervision, shift foreman and stillman were made in accordance with Baton Rouge experience. Reasonable allowances are believed to have been made for mechanical labor repair materials and analytical work. The total operating costs including overheads amount to approximately \$9000 per month and with a contingency item \$10,000 per month.

Operating Cost for Fischer Pilot Synthesis Plant

	Cost, \$/Month	
	I	II
<u>A. Salaries</u>		
Technical (Sup. and Data)	600	
Shift Foreman (1/5 of 5)	260	
Analyst, etc. (1 av.)	175	
	<u>\$1035</u>	\$1,050
<u>B. Wages</u>		
Stillman	200	
Operators (3/shift)	2230	
Porters (1/2)	40	
Mechanical (Incl. Instr., Turnarounds)	700	
Clerks, analysts (2 av.)	320	
	<u>\$3490</u>	3,490
<u>C. Materials</u>		
Repair Materials and Misc.	500	500

	Direkt	O.H.	Total
D. Utilities	\$ 325		\$ 325
E. Refinery Burden			
Oper. Labor and Salaries, 23%		\$ 885	
Mech. Labor 60%		420	
F. D. and R. Burden			
Oper. Labor and Salaries, 60%		2310	3615
	\$ 5370	\$3615	\$ 8985
Contingency allowance			\$ 1015
Total Cost per Month			\$10000

Allowing at least one year experimental work a total of \$120,000 for operation plus \$50,000 for equipment or \$170,000 would be necessary for this investigation.

B. SYNTHESIS GAS REGENERATOR STUDY

The preliminary study of synthesis gas production by the make and blow system would probably involve considerable duplication of work reported in the literature (Storch - Bureau of Mines, Ind. Eng. Chem. 24, 23, 1932) in order to develop a suitable catalyst and at the same time obtain operating experience and indications of space velocity, including the effect of particle size. This work would be performed in a reactor of about 1 CF volume. Considerably more development work will then be necessary to incorporate those results in the operation of a full size regenerator as pictured by the Kellogg Co. It will be impossible to determine in small scale experiments the difficulties and requirements which will probably arise in the larger scale design.

The original plan with regard to regenerator studies was to utilize if possible the experimental furnace which the Shell Co. have at Shell Point, Calif. After reviewing our description of the proposed make and blow equipment and process the Shell people advised that their equipment would not be suitable. It was impossible to completely design a pilot regeneration unit before the visit to Baton Rouge and hence the following investment and operating costs largely reflect the order of magnitude of the cost which may be involved in a small scale preliminary investigation of this process.

Investment for Experimental Synthesis Gas
Regenerator Equipment.

1. Regenerator, 1 CF cat. cap. allow	\$1,000
2. Air blower	1,000
3. Automatic valving, timer, flow-meters	3,000
4. Holder and Meter	500
5. Erection	2,000
	<u>\$7,500</u>
Eng. Contingency and allowance for catalyst preparation	2,500
	Total...\$10,000

The following operating costs were to a large extent prorated from those arrived at in connection with the Fischer pilot unit. If both of these jobs were conducted at the same time in nearby areas, a certain amount of saving in supervision expense would be made and it is believed that these costs can be assumed to reflect this condition.

Operating Cost for Synthesis Gas Regenerator
Studies.

	<u>Cost, \$/Month</u>	
	<u>DIRECT</u>	<u>TOTAL</u>
<u>Salaries</u>		
Technical, 1 man	250	
Shift Foreman (1/15 of 5)	90	
	<u>340</u>	340
<u>Wages</u>		
Operator (1/shift)	75	
Stillman	75	
Mechanical	225	
Analyst	150	
	<u>1185</u>	1185
<u>Materials</u>		
Repair	150	150
<u>Utilities</u>	100	100
<u>Refinery burden</u>		
Oper. Labor and Salaries, 23%	300	
Mechanical Labor, 60%	135	
<u>D. and R. Burden</u>		
Oper. Labor and Salaries, 60%	915	1350
	<u>1775</u>	<u>3125</u>
Contingency allowance		375
<u>Total Cost per Month</u>		<u>\$3500</u>

If this equipment were run independently of the Fischer pilot unit and had to obtain CO₂ directly from cylinders it would involve an expenditure of \$4000 per month, on a total cost basis.

It is rather difficult to judge how long it would be necessary to operate this equipment to obtain the results desired but assuming this would be at least 3 to 4 months, the total money involved in the study would be about \$25,000. This, together with the costs involved for the Fischer pilot unit, brings the total expenditures to approximately \$200,000.

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