N O T I C E

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SOCONY MOBIL OIL COMPANY, INC.

RESEARCH DEPARTMENT

M O N T H L Y P R O G R E S S M E M O R A N D U M

(Covering June 16 to July 15, 1964)

ANVIL POINTS OIL SHALE RESEARCH CENTER

Rifle, Colorado

July 15, 1964

CONTRIBUTORS:

Mechanical Engineering
Retorting Section
Analytical Laboratory Section
Engineering Analysis

Signed by:

R. H. Cramer,
Program Manager

NOTICE

The primary object of the Anvil Points Oil Shale Research Center MONTHLY PROGRESS MEMORANDUM is to advise authorized personnel employed by the Participating Parties[1] that various activities are in progress or that certain significant data have been obtained within the Research Center.

These MONTHLY PROGRESS MEMORANDA have been prepared to provide rapid, on-the-spot reporting of research currently in progress at Anvil Points. The conclusions drawn by project personnel are tentative and may be subject to change as work progresses. The PROGRESS MEMORANDA have <u>not</u> been edited in detail.

[1]Socony Mobil Oil Company, Inc. and Humble Oil & Refining Company

MONTHLY PROGRESS MEMORANDUM

(Covering June 16 to July 15, 1964)

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CONFIDENTIAL

MONTHLY PROGRESS MEMORANDUM

Anvil Points Oil Shale Research Center
Rifle, Colorado

(Covering June 16 to July 15, 1964)

I. TECHNICAL ADVISORY COMMITTEE

The first meeting of the Technical Advisory Committee was held on June 29, 1964 at the Socony Mobil Building in New York City.

The Program Manager presented a budget of about $910,000 net expenses for the operation of the Research Center during the period May 1 to December 31, 1964. The Committee took the budget under advisement and will act upon it at the next meeting.

It was decided that the Research Center will issue reports in the following categories:

A. Monthly progress report on entire program.

B. Memorandum when a significant phase of some portion of the program is completed. (These will be informal with a minimum of editing at Anvil Points and no editing elsewhere by Project Manager.)

C. Formal reports as needed upon the completion of the program or of major segments of the program. (These will be final reports by Project Manager.)

Copies of A and B reports will be sent directly to Participating Parties by the Program Manager upon request.

The next meeting of the Technical Advisory Committee will be held at Anvil Points on September 3 and 4, 1964.

II. ADMINISTRATION

Staffing of the Anvil Points Facility by the Research Foundation has been proceeding approximately according to plan. As of July 13, their personnel on site totaled about 55 out of a projected 74. Non-technical staffing of the Technical Development Department will start on or about August 1.

Technical staffing by the Participating Parties has encountered some delay and could become critical.

The following personnel have been assigned by the Participating Parties:

Socony Mobil		Humble	
R. H. Cramer	Program Manager	J. E. Lawson	Sup. Chem. Engr.
W. S. Bergen	Staff Mech. Engr.	P. H. Gifford	Chem. Engr.
P. W. Snyder	Engr. Analyst	C. W. Tyson	Chem. Engr.
T. C. Lyons	Chem. Engr.	J. E. Burchfield	Engr. Analyst
K. I. Jamel	Chem. Engr.(Arr.7/20)	B. L. Beck	Sup. Chemist
L. J. Skowronek	Chem. Engr.(Arr.8/1)		
D. Liederman	Chemist		
Boyd Guthrie	Consultant		
C. J. Verdeur	Adm. Assistant		
Mrs. Ruth Lawson	Secretary		

To Be Supplied

1	Sup. Mining Engr.	1	Chem. Engr.
		1	Mining Engr.

Sinclair Oil is still considering joining the program as a Participating Party, but chose not to execute the agreements prior to June 29. Therefore, Sinclair will not have staffing rights.

III. MECHANICAL ENGINEERING (W. S. Bergen)

Reactivation of the Anvil Points Oil Shale Research Center has continued at a rapid pace during the last four weeks. In this effort, progress has been a function of manpower staffing capabilities.

Mechanical Engineering assignments and responsibilities during this period have centered on:

1. Continuance of the mechanical design of the No. 1 retort and associated equipment for shale throughput rates through 750 lbs./(Hr)(Ft^2).

2. Design and selection of all controls and equipment to convert the shale handling for the No. 1 retort to a complete automatic system.

3. Inspection and field engineering of the construction of the new pilot plant.

4. Coordination and direction of the rehabilitation of the plant to an operational status.

Summary

1. The design and drafting for all structural changes, the gaseous piping, the spent shale weigh bins, the demisters

and location of the liquid product handling system has been completed and issued for construction.

Designed, but not completed in drafting, are the liquid product handling tanks, the liquid piping from the recovery equipment and shale stand-pipe to the top of the retort. These will be completed next week.

All major mechanical equipment except one small conveyor at the discharge spent shale bin and the line burner have been selected and ordered.

2. All equipment and controls needed to automate the shale handling from the storage bins through the retort and out to the spent shale bins have been selected and ordered.

3. All piping and equipment have been cleared from the pilot plant and new structural members are being installed.

4. Since June 29, daily meetings have been held with the Colorado School of Mines Research Foundation supervisory staff to discuss the progress of the completed day's work, the work schedule for the next day, and to iron out any manpower or material problems.

Weekly meetings are also being held to review the over-all progress and problems associated with the rehabilitation effort.

Discussion

A. Design of Mechanical Equipment for Retort

Informal discussions are being held daily with J. E. Lawson as the design of the new retort pilot plant progresses. Completed and issued to the shops is the piping lay-out for the gas and mist product. All materials for this system have been ordered and are either on hand or will be delivered in time to meet installation schedules.

The demisters are being fabricated in Grand Junction and will be on site next week. All control valves, line heaters and pipe insulation with their controllers have been ordered.

A selection of thermocouples for use in the retort, gas, and liquid piping have also been ordered. The liquid product tanks have been designed. One tank will be used to weigh the liquid product for a two-hour period, and one tank will be used to accumulate liquid product from the high pressure side of the compressor for a four-hour period. The third tank will be used to accumulate and weigh the total product for a four-hour period.

Glass accumulators to measure and accumulate product for ten minute intervals have been ordered. These glass accumulators will be located in the liquid line from each piece of recovery equipment. The accumulators should give us the ability to measure the effectiveness of the various pieces of recovery equipment.

B. Shale Handling Equipment

Shale handling equipment to automate the supply of shale through the retort have been selected and ordered. The system essentially consists of: (1)the use of the existing Richardson scale weigh bins, (2)a Syntron Gravimetric automatic feed control system to be located at the base of the 60-ton hopper, (3)a Gamm-O-tron Nuclear level gauge to sense and control the shale level at the top of the stand-pipe on the retort, (4)a Brown Airoline controller to receive the signal from the Gamm-O-tron sensing device and control the speed of our table feeder at the discharge of the retort, (5)a Myers 8 x 8 Airlock for five pounds difference in pressure, (6)a renovated existing conveyor located in our surplus equipment to convey spent shale from the retort, (7)a Toledo scale and four-hour weigh bin for spent shale, and (8)a small conveyor to discharge spent shale directly from the four-hour weigh bin to a truck.

C. Construction of the New Pilot Plant

Shop personnel have been dismantling all piping and equipment from the No. 1 retort. Most of the equipment is being saved and all piping is being discarded. The installation of structural steel is progressing and piping will start next week.

D. Plant Rehabilitation

A detailed PERT schedule for the plant rehabilitation and retort facility rebuilding has been developed. These PERT schedules went into effect June 29 when most of our shop manpower was available. Meetings with J. M. Petty, L. W. Lewis and S. D. Corsuch of the Research Foundation are being held at the completion of each day to review progress and future plans. The total manpower requirement for the next 30 days will be developed next week when the needs for manpower for the Analytical Laboratory are established.

Weekly meetings to discuss over-all progress of rehabilitation are continuing. These meetings have been very effective in coordinating programs and responsibilities for all concerned. Manpower needs are quickly developed and authorizations for accelerated hiring are granted when deemed necessary. A copy of the latest PERT schedule of July 10 is attached.

IV. RETORTING SECTION

A. Technical Staffing (J. E. Lawson)

Because of the difficulty in getting technical personnel released from other assignments, staffing of the retorting section has fallen somewhat behind schedule. The original schedule called for three retort engineers to be on hand by mid-June with the remaining three to be available by mid-July. In contrast with the foregoing plan, one engineer, P. H. Gifford was on site on June 15. Another, T. C. Lyons, arrived at the job on July 1. C. W. Tyson is now expected to arrive on July 17. K. I. Jagel will report for a two week period beginning July 20 but will then be required to return to his present job assignment for about three weeks before reporting for permanent duty. L. J. Skowronek will report for permanent duty about August 1. The remaining retort engineer has not been named by Humble; and, therefore, his reporting date is unknown.

- consequence of the above shortage of technical personnel, only the most critical of technical assignments are being undertaken at the present time. Reports of the two engineers on hand, P. H. Gifford and T. C. Lyons, regarding their activities are presented in subsequent paragraphs. C. W. Tyson on his arrival will be given as his initial assignment the next most important function - shale management and preparation. An idea of the scope of this work is presented below.

Some 5,000 tons of shale is available in six stockpiles in the plant and mine areas. The piles contain shale of various sizes from mine run to crushed minus three-inch. Nothing is known at present about the assay of each pile or the uniformity within piles or between piles. In order to develop an orderly program of crushing and blending of shale to supply the pilot retorts, the first step in the shale management program will be to sample several truckload quantities at appropriate spots from each pile and run each separately through the crushing plant to develop small samples for assay. This will be a time consuming effort and will require several units of heavy mobile equipment and the operators for these and the crushing plant. Results from this initial step will determine future steps to be taken in the program which may well include mixing of individual piles, cross-blending between piles, etc. all using heavy equipment and operators. It is anticipated that shale availability may become a problem during the latter stages of Stage I. The shale management program outlined above will help insure maximum utilization of the shale available.

B. Operator Manual and Operator Training (P. H. Gifford)

After obtaining some preliminary background information on the history and operation of the Gas-Combustion Retort the task of rewriting the Operator's Instruction Manual was undertaken. The purpose of this manual is to give in detail information and instructions concerning the operation of the No. 1 Retort. Although the basic design of this retort will remain unchanged there are a number of changes to be made in the auxiliary units - such as the raw shale feed system, spent shale removal system, and the liquid product recovery system. Although the details of operation of this new equipment are not completely known at present, a draft of the manual was prepared using information available. Changes incorporating new details as information becomes available they can be made with a minimum of time lost. A broad outline of the manual is given below:

FOREWORD
GENERAL INSTRUCTIONS
DESCRIPTION OF PROCESS
PRELIMINARY INSTRUCTIONS
START-UP
NORMAL OPERATION
SHUTDOWN
SAFETY
EMERGENCIES

Copies of the initial draft were distributed to the technical people for their comments. When these are received and when more information is

available on the final over-all design, the working draft will be written and made available to the operating personnel.

The Operator's Instruction Manual will serve as the textbook for the operator's training course. It is the purpose of this course to explain in detail the operation of the No. 1 Retort and to expose the operators and their helpers to the actual equipment. The course will last one week and will consist of both classroom and laboratory type instruction. A brief outline of the subjects to be covered is given below:

PURPOSE
CONDUCT
PROCESS FLOW DIAGRAM
START-UP
DATA SHEETS
SAMPLES
SHUTDOWN
EQUIPMENT DEMONSTRATION

So that each man may obtain valuable first hand experience in the operation of the various components, greater emphasis will be placed on the laboratory portion of the course.

C. Mechanical Model Studies (T. C. Lyons)

A program has been prepared which outlines the studies to be carried out in the early phase of the mechanical model work. The broad objective of this work is: (1)to develop feed and drawoff schemes which will provide for uniform shale flow through large vessels and (2)to evaluate promising air and gas distributor designs.

The first efforts will be directed toward obtaining some basic data concerning the flow characteristics of oil shale. This will include determining the flow capacity of various-size pipes, orifices, and rectangular slots and measuring flow angles and coning heights in moving shale beds. The effect of particle size will be studied and the flow characteristics of spent and raw shale will also be compared. Sectional models will be designed to facilitate visual observations wherever possible. The first models will be simple yet flexible in order to obtain a maximum of information at minimum cost. More elaborate models will be designed after the problems are better defined.

Similarly, a program has been outlined to evaluate promising air distributor designs. Of immediate importance is the development of an "ideal" distributor specifically designed for the small retort (No. 1) since most of the process studies in Stage I will be carried out in this unit.

V. ANALYTICAL LABORATORY SECTION (B. L. Beck)

Summary

The two technical people in the laboratory have spent about 75% of the past month at Anvil Points; our first laboratory technician has been

assigned to the laboratory effective July 13th. The initial equipment order is complete and totals about $8,500. Details of the initial tests are being organized and an outline of the initial test procedures has been issued to research personnel. Laboratory clean-up is progressing satisfactorily.

Discussion

A. Personnel

B. L. Beck (Supervisor) has spent about half of the last month at the laboratory; in addition he has moved his family and household goods to Anvil Points. D. Liederman (Chemist) has spent about the entire past month in the laboratory and has recently returned to New Jersey to make preparation to move his family and household goods to Anvil Points. A. W. VanArsdale, from the labor pool, was assigned for about three weeks to the laboratory for clean-up work; effective July 9 he was transferred to the laboratory as our first laboratory technician.

B. Equipment

The initial ordering of equipment and supplies for rehabilitation of the laboratory is finished with an expenditure to date of about $8,500. Equipment is being received daily.

C. Tests

A memorandum was issued June 30 covering the outlines of the proposed initial analytical tests. This was to provide research personnel with more detailed information than on the proposed tests list issued in May.

D. Laboratory Rehabilitation

The initial clean-up of the laboratory has progressed satisfactorily and is essentially complete. Work on converting the old Fischer Assay set-up to electric heating, and other electrical and mechanical work has been a little slow, although not to seriously affect the over-all laboratory rehabilitation at this time.

VI. ENGINEERING ANALYSIS (P. W. Snyder)

A. Rehabilitation and Staffing

Objective: Relocate and establish communications link with Socony Mobil Computer Center.

Discussion

1. Relocation

A file system for new and background technical data has been developed.

James E. Burchfield of Humble Oil and Refining Company arrived July 13 to fill the remaining Engineering Analyst position.

2. Computer-Link

A sample retort material balance has been developed and sent to the Socony Mobil Engineering Department to be programed into their "Real Time System".

B. Engineering Analysis

Objective: (1)Establish the retort conditions which need further experimental definitions by means of a process variable study with the math model, and (2)develop guidelines for interrelating the economics of mining, crushing, and retorting.

Discussion

1. Process Variable Study with Math Model

Six of the initial twenty-five process variable computer runs have been completed. These runs give preliminary information on the effects of:

a. Preheating the air-dilution gas to about 1000° F. at shale rates of 300 and 750 lbs./(Hr)(Ft^2).

b. Increasing air-rate from 4000 to 5000 SCF/T at shale rates of 300 and 750 lbs./(Hr)(Ft^2).

c. Increasing retort height above the air inlet from 6 to 8 feet for shale rates at 300 lbs./(Hr)(Ft^2).

d. Increasing shale rate from 300 to 750 lbs./(Hr)(Ft^2).

The significant observations from these initial runs are shown in Table I. These results will be included in a series of curves showing the effect of process variable changes as soon as the remaining runs are obtained.

a. Effect of Preheating the Air-Dilution Gas The effect of preheating the air-dilution gas at low shale rates can be seen by comparing Run 3 with Run 1 in Table I. These results indicate that preheating should improve operations even at low shale rates because:

1. More kerogen is removed before the combustion zone is reached - the kerogen decomposed at the top of the combustion zone is 96% with preheat and only 5% without preheat. This should reduce thermal cracking due to less oil vapor passing through the hot burning surface of the shale.

2. The gas cooling rate in the mist forming zone is 15% greater - this should improve mist formation slightly.

3. The peak temperature moved in the direction which the Bureau of Mines observed improves yield - the Bureau noted that their best yields were obtained with "intense" temperature peaks close to the air-inlet.

Although not shown in Table I, preheating the air-dilution gas is required to arrive at a solution when operating at a shale rate of 750 lbs./(Hr)(Ft^2) or greater. Preheating may be necessary at shale rates as low as 500 lbs./(Hr)(Ft^2).

b. The Effect of Increasing Air Rate The effect of increasing air rate can be seen by comparing Run 2 with Run 1 and Run 9 with Run 8 in Table I. Increasing air rate 25% increased the peak temperature about 200° F. at the low shale rate and 50° F. at the high shale rate with preheat. Most of this additional heat went to raising the spent shale temperature and decomposing carbonates.

c. Effect of Increasing Retort Height The effect of increasing retort height above the air-inlet for low shale rates can be seen by comparing Run 4 with Run 1 in Table I. At this low shale rate increasing retort height had no significant effect other than to increase the distance the oil mist has to pass before being removed from the retort. Therefore, increasing height does not look advisable for low shale rates.

d. Effect of Increasing Shale Rate Preheating the air-dilution gas was required for solution of the high shale rate runs; therefore Run 9 should be compared with Run 3 to see the effect of increasing shale rate. The main effect was to increase the gas cooling rate from 1450° F./sec. to 2600° F./sec. which should improve mist formation. There was a slight shift of the peak temperature up away from the air inlet and a 30° F. increase in spent shale temperature. Although the amount of kerogen decomposed at the top of the combustion zone is not yet available, operation at 750 lbs./(Hr)(Ft^2) appears feasible.

The results from these runs will be incorporated into a series of curves showing the effect of changing process variables as soon as enough runs have been accumulated to point out the significant effects.

2. Development of Economic Guidelines

No work was done on developing economic guidelines during the month of June.

TABLE I

INITIAL RESULTS FROM MATH MODEL PROCESS VARIABLE STUDY

Retort Length Below Air Inlet - 6 Feet
Shale Size - 1 Inch
Fischer Assay - 30 Gal/Ton
Total Recycle Gas - 16,000 scf/Ton
Air-Dil. Gas Ratio - 0.4
Brine Addition - 15 lbs/Ton

Run No.:	1	2	3	4	8	
Operating Conditions Varied:						
Retort Height Above Air Inlet, Ft.	6	6	6	8	6	6
Shale Rate, Lbs/(Hr)(Ft^2)	300	300	300	300	750	750
Air to Line Burner, SCF/T	4000	5000	4000	4000	4000	5000
Air-Dil. Gas Temp., °F.	217	132	927	149	1132	953
Results:						
Temperatures, °F.						
Offgas	133	133	133	131	137	137
Spent Shale	285	328	248	288	279	308
Peak Shale	1140	1254	1201	1131	1246	1305
Peak Gas	1175	1400	1335	1160	1390	1512
Decomposition, %						
Kerogen at Top of Comb. Zone(1)	5	(3)	96	(3)	(3)	
Kerogen where 75% of O_2 is Consumed	70	(3)	100	(3)	(3)	
Carbonates in Spent Shale	9	23	14	9	14	22
Gas Cooling Rate(2) °F./Sec.	1250	1300	1450	1250	2600	2600
O_2 Used to Burn Coke, %	58	43	26	60	21	18
Hgt. of Peak Temp. Above Air Inlet, Ft.	0.7	0.8	0.3	0.7	0.5	

(1) Top of Combustion Zone is where 90% of the O_2 is consumed.
(2) In the mist forming zone of 400 to 700° F.
(3) Information in route from Paulsboro.