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MOBIL OIL CORPORATION

RESEARCH DEPARTMENT

TECHNICAL MEMORANDUM NO. 66-7

THE 1/12TH SCALE MODEL OF RETORT NO. 3 - COMMENTARY ON TECHNICAL FILM NO. 66-2

ANVIL POINTS OIL SHALE RESEARCH CENTER

Rifle, Colorado

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The primary object of the Anvil Points Oil Shale Research Center TECHNICAL 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 TECHNICAL 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 TECHNICAL MEMORANDA have not been edited in detail.

[1] Mobil Oil Corporation, Project Manager

Humble Oil and Refining Company
Continental Oil Company
Pan American Petroleum Corporation
Phillips Petroleum Company
Sinclair Research, Inc.

THE 1/12TH SCALE MODEL OF RETORT NO. 3 - COMMENTARY ON TECHNICAL FILM NO. 66-2

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TECHNICAL FILM - 66-2

THE 1/12TH SCALE MODEL OF RETORT NO. 3

Approximate length of film - 175 feet
Approximate projection time - 7 minutes

I. SUMMARY

This film deals with a plexiglass model which was built as a 1/12th scale replica of Retort No. 3. The primary purpose of the model was to illustrate the gas distributor hardware and the shale feed and drawoff techniques which were proposed for the initial design of Retort No. 3. Although the model was built originally for demonstration purposes, it was found to be a valuable tool for studying shale flow. Therefore, the film includes a flow sequence with shale which was scaled down to a 1/12th simulation of 3/4 to 1 1/2 inch particles.

II. COMMENTARY

To assist in the synchronization of the commentary and the film, the titles are reprinted here just as they appear in the film.

TITLE

SCALE MODEL
RETORT NO. 3
SCALE 1" = 1'0"

A. Overall View of Entire Model (Front View)

The first sequence shows the general orientation of the shale drawoff system, the recycle gas distributors, the air distributors, and the shale inlet system. In the front view, the model is 10 inches wide which represents the 10 foot dimension of Retort No. 3.

B. Panorama (PAN) From Bottom to Top of Retort (Front View)

This sequence begins with a closeup of the shale drawoff system. With this system, spent shale is withdrawn from the retort through six pipes and these pipes are manifolded into a single outlet by means of a conical transition section. (Detailed views of the drawoff assembly are shown later in the film).

The film then moves to include the recycle gas distributors. Shale flow studies revealed that the spacing of the recycle distributors is critical. In order to obtain adequate shale flow at the walls, the distributors had to be equally spaced on two foot centers as shown in the film. The shape of the distributor element was also found to influence the uniformity of shale flow above the element. A sharp leading edge was found to be desirable from the flow standpoint. However, the distributors shown in the film have a round blunt leading edge and are not typical of those proposed for Retort No. 3.

The camera was then moved upward to include the air distributors and show their position relative to the recycle distributors. The riser configuration can be considered as typical since the number of risers and the design of the riser manifold will differ depending on the shale size. However, regardless of riser design the air will be fed to the risers through three main headers as shown in the film. (Further details of the air distributors are shown later in the film).

Following the air distributor section the film moves upward to the shale inlet system. Basically, the inlet system is made up of six pipes which feed the 60 square feet of retort area. These small pile sizes are required to minimize particle segregation. It should be noted that Retort No. 3 will have vapor collectors above the top of the shale bed; however, these are not present in the model.

C. PAN From Bottom to Top of Retort (Angle View)

The angle at which this sequence was taken shows the six inch dimension (simulated six foot dimension) as well as the ten inch distance. Thus, the orientation of the retort intervals can be seen in three dimensions.

TITLE

SINGLE LEVEL
DRAWOFF SYSTEM
1 PIPE/10 SQ. FT.

D. Details of Single Level Drawoff System

In this sequence the drawoff system was removed from the model so that the individual components could be shown in

detail. The first view is that of the floor plate of the retort vessel. This shows the position of the six 20 inch drawoff pipes. The floor plate is then rotated to illustrate how the six pipes are brought together into a circle. (Curved pipes were used in the model but the pipes are straight and angled in the full-scale unit).

Following the pipe assembly, a view of the conical outlet section is shown. The conical annulus is divided into six equal areas or one area for each drawoff pipe. The cone then narrows down into a single outlet pipe. This outlet pipe must have enough vertical height to "calm out" any distortion to flow which is caused by the feed mechanism at the outlet (screw conveyor, belt feeder, etc.)

Thus, by using the single level drawoff technique, the flow of solids can be transmitted from a single pipe to a conical annulus and then to a multiplicity of pipes which are drawing from a large vessel area. The flow through the vessel is uniform because the flow rate through each of the pipes is equal. If required, adjustments in flow can be made by adjusting the spacing of the vanes in the conical annulus.

TITLE

RISER AIR DISTRIBUTOR APPROX. 1 RISER/SQ. FT.

This section of the film illustrates the type of hardware used to distribute the combustion air within the shale bed. The number of risers will vary depending on the shale size but it is anticipated that the number of main headers will remain at three.

E. Details of Riser Air Distributor Assembly

The film shows a closeup of a single header assembly. This header contains six manifolds and each manifold assembly contains three vertical risers. Retort No. 3 will have three such headers, therefore, in this example the total number of risers would be 54 or 0.9 risers per square feet of retort area.

TITLE

SHALE FEED SYSTEM 6 FEED LEGS

F. Details of the Raw Shale Feed System

In this sequence the feed assembly was removed from the model to show the details of the system. It will be noted that it is essentially the inverse of the drawoff system. The shale must be spread from a single, relatively small source to a large area while minimizing particle segregation. In order to minimize segregation, the shale piles must be kept small; therefore, six pipes (20 inch diameter) are used to feed the 60 square feet of retort area. (As pointed out previously, curved pipes are used in the model but not in the full scale unit).

A conical section is provided to serve as a transition between the feed pipes and the single supply source. In addition the shale level will be monitored and held in this transition section. The hour glass shape increases the annular area in the top section and this forces the shale level to rise at a decreasing rate. Thus, level control is facilitated.

TITLE

MODEL RETORT NO. 3 NO INTERNALS 6 PIPE DRAWOFF SIMULATED 3/4 - 1 1/2 INCH SHALE

The following sequences demonstrate the uniformity of shale flow through the retort vessel with and without internal hardware. In this type of study the model is filled with shale which is scaled down by 1/12th. (In this example, a shale size of 3/4 to 1 1/2 inch was simulated). The surface is leveled and the shale is drawn down slowly. Changes in the surface profile indicate distortions in flow.

G. Shale Flow Without Internal Hardware

In this drawdown, the flow is uniform to within six or seven inches of the bottom drawoff plate. (Note: By making further adjustments to the vanes in the drawoff system the uniform flow could be brought closer to the bottom plate).

TITLE

MODEL RETORT NO. 3 RECYCLE & AIR DISTRIBUTORS IN 6 PIPE DRAWOFF SIMULATED 3/4 - 1 1/2 INCH SHALE

H. Shale Flow With Internal Hardware

In this drawdown, the surface profile is distorted as the level approaches the air distributors. There is little change in the pattern in the region between the air distributors and the recycle distributors.