ENGINEERING

Oil Use Overtaxes Production

While the many advantages of this fuel are bringing it into increasing use, refining and transportation create a bottleneck in the available supply.

By A. C. MONAHAN

➤ THE convenience and cleanliness of fuel oil can be blamed in large part for the present so-called shortage. Hundreds of thousands of new oil-burning installations, for both heat and power, have created demands which overtax production.

The bottleneck in the available supply is in refining and transportation. Additional refineries are needed, but these complicated, elaborate plants costing millions of dollars can not be built in a day. Nor can they be built without the necessary steel. Refineries, pipelines, storage tanks, shipping cars and tankers are steel. This metal is a number one essential in the oil industry.

Many thousands of homes have installed oil-burning furnaces since the war, and prewar oil-burners that were converted to coal as a war measure are back on oil again. Thousands of office, school, hospital and factory buildings are now using oil for fuel, one reason being to save labor costs.

Mechanical Power

Thousands of diesel engines are now doing the work formerly done by coal-burning power-plants in factories, and even in locomotives. Mechanical power has made great strides in replacing animal power on the farm, and thousands of jobs on roads, in timber and mines, formerly done by hand labor, are now carried out with oil- or gas-burning machines.

There is enough crude oil in proven reserves in American earth to meet all domestic needs of the next decade or two, even if the requirements increase 50% in the next 10 years as predicted. But petroleum as mined can not be used in a furnace, engine or automobile. It must be refined. That means that it must be purified and separated into its hundreds of usable constituents—asphalt, road oils, lubricating oils, waxes, fuel oil, gasoline, naphthas and many sources of raw chemicals needed in daily life.

Few oil fields are located near consumption centers. That means that elaborate transportation facilities are necessary from fields to refineries, from refineries to distribution centers, and from them to local consumption areas.

Because of the shortage of steel, the enormous cost of erecting refineries, and for other reasons, the oil industry has tried to meet the increasing demand with present plants by searching out and eliminating all bottlenecks in the processes used. Also refineries have been converted from old-type equipment into improved forms wherever possible.

Step-up in Production

The result is a great step-up in production even if not sufficient to meet the greatly increased demands. The supply of fuel oil and gasoline will probably be limited for another year or so.

To make all the usable products that are obtained from petroleum, the crude must go through a cracking process. In this, molecules are broken down, and molecules of a different sort are set up. By cracking, heavy oil can be converted into gasoline. This makes it possible to obtain a much greater quantity of this automobile fluid than can be obtained from the crude by mere distillation.

One of the greatest steps taken in oil refining is the replacement of the early thermal cracking process with the catalytic cracking method. Prewar catalytic cracking methods have now been replaced with what is called a solid "fluid" catalyst technique. This uses an extremely finely powdered dry material which acts much like a liquid in its behavior.

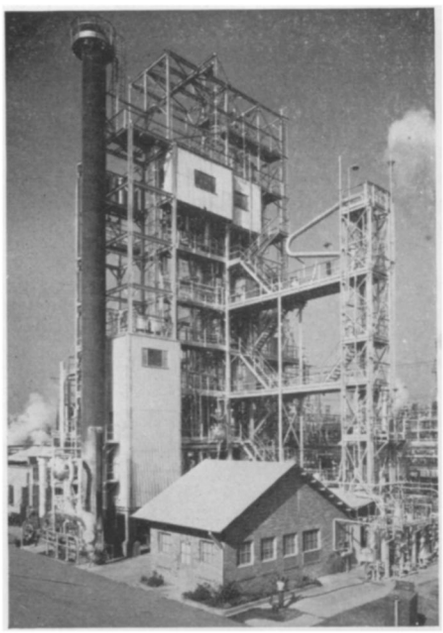
Conversion to the fluid catalyst technique has been one of the most important steps taken by the oil industry. The process is rapid, permits the breaking up of the heavy oil at a lower temperature than would be required otherwise, and influences the cracking in such a way as to give gasoline a lesser tendency to knock. This fluid catalyst technique produced the 100-octane aviation fuel that gave American aviators supremacy over the enemy in the air.

A catalyst is a substance whose presence promotes chemical action in some mysterious way, but which does not itself undergo any chemical change. In early catalytic cracking of petroleum, a solid clay-like material was used. The great problem was how to mix the gaseous petroleum with it and to separate the results, and particularly how to clean the catalyst of the carbon which collected on it during the process and made it finally valueless.

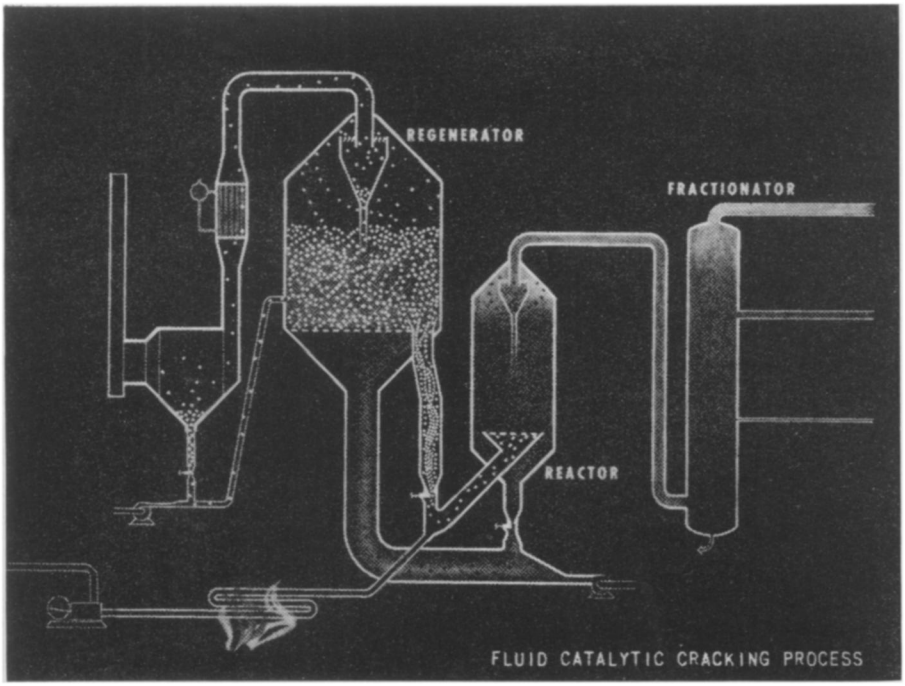
Fluidized Solid Catalyst

These problems are well solved by the fluidized solid catalyst now used. It looks like very fine white sand, and chemically is a synthetic product of alumina and silica. When air from underneath is blown up through the material, its surface becomes much like that of frothy soapy water.

Investigations at the Massachusetts Institute of Technology, sponsored by the Standard Oil Company of New Jersey, pointed the way to the development of this fluidized solid catalyst technique. Further developments were carried out at the company's research center at Baton Rouge. The developments at Baton Rouge were in pilot plant stage when the



PILOT PLANT—The oil industry conducts much research in these plants to determine the best commercial processes. This is one of the new installations at the Esso Laboratories, Baton Rouge, La., owned by Standard Oil.



OIL REFINING—The greatest advance in this field was made when the early older cracking process was replaced by fluidized catalytic cracking method, illustrated in the diagram.

war came. They were put immediately into commercial use, particularly to obtain the 100-octane aviation fuel, and fortunately were successful.

In the operation of the fluid catalytic cracking process, preheated crude oil enters the base of a giant steel retort, called a reactor, which may extend up in the air as high as a 10-story building. It carries in with it catalytic material as a suspended dust, and it passes through a bed of the material in the retort that may be 20 feet thick and 45 feet in diameter.

The suspended dust in the oil settles out in the bed which bubbles on the top much like boiling water. Cracking takes place in this bed, at a temperature of 900 degrees Fahrenheit, as the rising oil vapors come in contact with the sand like grains, and is completed in about 20 seconds.

Part of the catalyst, with carbon clinging to it, rises in the retort with the newly created vapors, but is separated by whirling air and passes by air pressure to a heating chamber, called a regenerator, where the carbon is burned off. Then the cleaned catalyst drops into the entering pre-heated crude, and makes another cycle. There are no mechanical pumps to help it on its journey. The air pressure is sufficient. It is the fluid condition that makes this possible.

Catalysts are also important in making fuel oils and gasoline from natural gas, and from coal. The present known petroleum reserves in the United States will take care of domestic needs only for a decade or two, it is claimed, but America will have home-produced liquid fuels for 1000 years or more. If no more petroleum can be found, it will come from natural gas, coal and oil shale. The coal supply is practically unlimited. There is also a great abundance of oil-producing shale.

Natural Gas Limited

The supply of natural gas is limited, but liquid fuels can be made from it for the next 25 years or so without exhausting the amount needed for gas lighting and heating. Fuel oils and gasoline can be made from natural gas at a cost that will permit their sale in competition with petroleum products. Liquid fuels from coal and shale will cost more to produce.

Already two plants are under construction, one in Texas and the other in Kansas, to use natural gas as a raw material. Much research has been conducted by the U. S. Bureau of Mines and by the oil industry to find the most satisfactory processes. One of the major projects at the Esso Laboratories of Standard Oil (N. J.) at Baton Rouge is concerned with this process. Another is with problems involved in making liquid fuels from coal. The two processes have much in common.

Do You Know?

Furfural, known for over a century but used commercially only in the past two decades or so, promises to become a very important raw material in chemical synthesis; it is now extensively used in making nylon.

Some gardeners recommend the application of a complete *fertilizer* to a level lawn while snow is still on the ground; spring thaws will carry the plant food down to the roots to be available when growth starts.

A new *insecticide,* Thiophos 3422 for short, but diethyl nitrophenyl thiophosphate chemically, is claimed to kill a wider range of insects than any chemical now in use including DDT.

Water should not be used to put out a *fire* around electrical equipment until the current has been cut off at the switch.

A giant plant will soon be constructed in Pennsylvania to use coal in making liquid fuels. Pilot plants of the U. S. Bureau of Mines are pointing the way. The coal is first converted into water gas by a process long used to supply manufactured gas for homes in many American cities. From there on, the conversion of this product into liquid hydrocarbonates is similar to that used with natural gas.

The gases are first converted into carbon monoxide and hydrogen by an incomplete combustion or other process. These, with the help of an iron catalyst in a fluidized state, become the synthetic hydrocarbonates and water.

There is enough oil shale in America to yield over 95,000,000,000 barrels of gasoline if all could be extracted. When this rock is crushed and heated it gives off hydrocarbon vapors and gases much like those of petroleum which then, of course, have to be refined. The process is still costly, but a government pilot plant at Rifle, Colo., promises cheaper products as better methods are developed.

Science News Letter, February 21, 1948

SCA NEWS

National SCA Meeting

All members of Science Clubs of America are invited to attend by tuning in to CBS radio program on Saturday, Feb. 28, for future of science discussion.

➤ THE first national meeting of Science Clubs of America, with 15,000 clubs in the nation's secondary schools, will be held on Saturday afternoon, Feb. 28, when Science Service's "Adventures in Science" radio program over the nationwide network of the Columbia Broadcasting System will be devoted to this important event.

Originating from the Seventh Annual Science Talent Institute at Washington, being attended by the 40 winners competing for the Westinghouse science scholarships, eminent scientists will discuss "Great Future Problems of Science."

Several hundred thousand SCA members are expected to join the regular radio audience listening to this program directed by Watson Davis and heard over most CBS stations at 3:15 p. m. EST, 2:15 p. m. CST, 1:15 p. m. MST, and 12:15 p. m. PST.

Sponsors and members reading this notice are asked to announce this national SCA meeting to all clubs by circulating notices or posting this article on school bulletin boards.

The meeting will be reported in the SCIENCE NEWS LETTER so that the subject discussed can be considered at individual club meetings later.

SCA Affiliation Without Cost

Any teacher or other adult who is the leader or sponsor of a science club, who has not already done so, should arrange to affiliate with Science Clubs of America. There is no fee for affiliation. As sponsors already affiliated know, the 100-page SCA Sponsor Handbook, sent free to sponsors, is an essential aid and guide to organizing and conducting a science club. Others may obtain a copy of this book postpaid by sending $1 to Science Service.

Science News Letter, February 21, 1948

ECOLOGY

Forest Remnant Reveals Character of Former Woods

➤ AN idea of what the great American woods were like in pioneer days is offered in a survey of a forest remnant made by Miss Millicent M. Sawyer, 16-year-old student at Wiley High School in Terre Haute, Ind. Although the tract she studied is only about 20 acres in extent, it gives roothold to no less than 37 species of native trees and shrubs.

The forest remnant is a triangular piece of land containing two creek valleys, a ravine and a central ridge, giving a considerable variety of habitat conditions. Although lumbering was carried on there in earlier times, there has been practically no cutting for almost 60 years, so that the forest has had a chance to re-grow.

Apparently the area was never completely cleared, for Miss Sawyer notes the presence of some century-old beeches with trunks 30 inches in diameter. Presence of numbers of sugar maples suggests that the original stand may have been the old Eastern beech-maple climax forest; dominant at present, however,