CHEMISTRY

Chemical Riches From Oil

Not Just Fuel, Oil and Natural Gas Also Yield Explosives, Drugs, Fertilizers and Plastics for War

By DR. FRANK THONE

OIL, natural gas, to most of us denote simply fuel. Used all our lives to thinking in terms of the car on the road, the range in the kitchen, the furnace in the basement, we go on thinking now in terms of planes roaring through the air, tanks charging across the battlefield, industrial furnaces flaming along the whole broad home front to keep the fighting forces well supplied.

But that is far from being the whole story of the usefulness of these gifts of the deep earth, in this time of all-out national effort toward victory over the would-be world looters who have attacked us. Under the generalship of scientists, oil and natural gas have been deployed into a hundred positions where they contribute mightily in the production of explosives, medical materials, raw-stuffs for industry, fertilizers for the increase of the food supply. They are not merely fuels, they are protean chemicals, doing the thousand things that have long since become traditional tasks of coal tar derivatives.

It would be impossible to review all the chemical magics now being wrought with oil and natural gas in anything less than a thick book. Suppose we confine ourselves to a quick look at just a couple of plants where petroleum goes in at one end and chemical products come out at the other.

Outstanding Plants

The two plants chosen for present purposes are among the establishments belonging to the Shell Chemical Company, one of the firms of the well-known oil concern. Both are in California, one at Shell Point, on the northern shore of San Francisco Bay, the other near Wilmington in the Los Angeles area. These are outstanding, yet typical of what great advances and wide departures from tradition have been made by what was once known as "oil chemistry."

The northern plant has as its main objective the manufacture of ammonia, old familiar strong-smelling stuff that fumed out of the household ammonia-water bottle, but grown now into one of the most potent of all the genii of wartime chemical industry.

Ammonia, before it is combined with water to make ammonia-water, is a very simple chemical compound. Represented by the chemical formula NH_3, it is composed of one part of nitrogen, three parts of hydrogen.

At the Shell Point plant, the raw materials used are ordinary air (oxygen and nitrogen) and a natural gas piped in from a number of gas fields in the region. This gas consists mainly of methane (CH_4), made up one part of carbon and four of hydrogen. The job is to take nitrogen from the air and hydrogen from the gas and combine them in the right proportions to make ammonia.

Cracking, First Step

The first step is to crack the gas. Cracking, in oil-chemical parlance, means running it through a tall tower filled with red-hot bricks. The heat rends the chemical bonds holding carbon and hydrogen atoms together, lets them both flow free. The carbon is washed out with water—we'll take a look at it later. The hydrogen still has a lot of gases mixed with it, which are also removed through several stages of purification processes, either to be run through the cracking tower again or to be sidetracked for marketing to other oil or chemical industries.

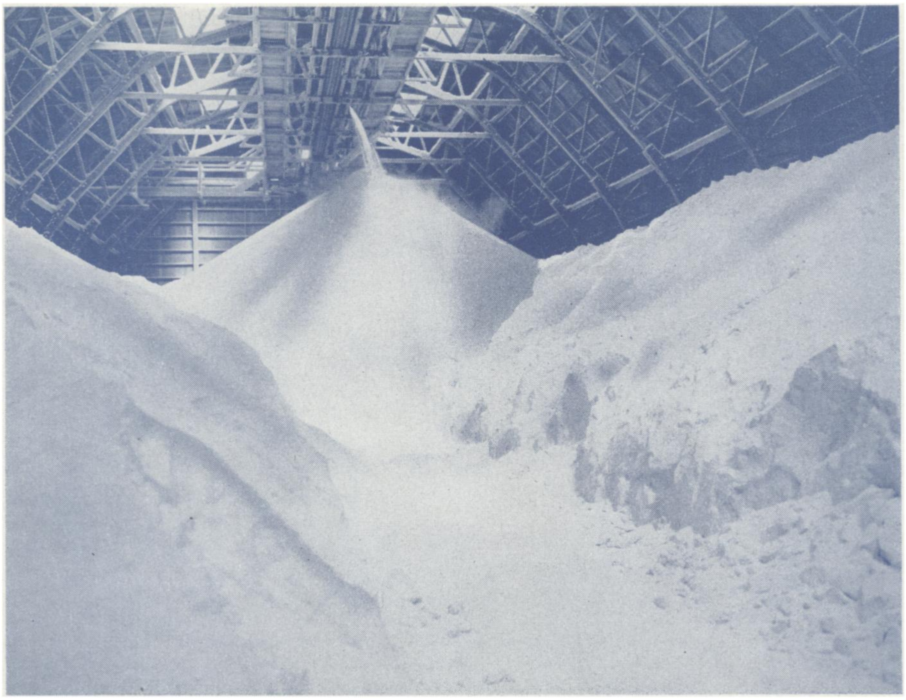
In the meantime, pure nitrogen has been manufactured in another part of the plant by compressing and chilling air until it has become liquid air, then letting the nitrogen boil off—it has a lower boiling point than liquid oxygen, which is left behind.

Purified hydrogen and nitrogen are then passed over a catalyst where they react to form ammonia (NH_3). As ammonia, the compound may be marketed as a gas compressed down to liquid state, or dissolved to make ammonia-water, or combined with sulfuric acid to make ammonium sulfate, a favorite fertilizer chemical.

Biggest market at present is the U. S. Government. Ammonia can be converted into nitric acid, which is then combined

FOR STEEL MAKING

Carbon from natural gas is briquetted to be used in making ultra-high quality steel.



FOR CROPS AND DESTRUCTION

From natural gas and air is made the fertilizer, ammonium sulfate, and the same processes that give chemicals for tastier truck crops, finer fruits and greener lawns, produce ammonia, basic stuff for TNT, amatol, high explosives for war.

with toluol (another product of the oil industry) to make TNT, or with cellulose to make guncotton, or with glycerin to make nitroglycerin. Nitric acid can also be hooked up with ammonia to make ammonium nitrate, which is then mixed with TNT, and under the convenience-name amatol is one of the best high explosives for bombs.

The carbon which we saw departing in the clutches of water, a moment ago, is precipitated out and dried. The finer particles are marketed as carbon black, one of the principal fillers used in the rubber industry. It is what makes black rubber black. The coarser part of the carbon (still pretty fine) is pressed into briquets and sold to metallurgists who eagerly take all they can get for the manufacture of ultra-high quality steel.

Alcohol, Too

From natural gas to ammonia, fertilizer, explosives, carbon for steel, is thus a radical but perfectly natural series of transformations. It is paralleled at the other plant, in southern California, where the lighter fractions of earth-oil become two kinds of alcohol, and these in turn become solvents, plastics, safety glass, even tear gas.

Two of the light constituents found in the gases obtained from refinery cracking operations are propylene and butylene. These are reactive hydrocarbons and are capable of being converted into alcohols. Propylene forms isopropyl alcohol which, in addition to being able to replace ethyl alcohol for many purposes, can be changed into acetone, a basic material used in the preparation of certain kinds of rayon, safety glass, photographic films, synthetic resins and tear gas. With the deadly gas, hydrocyanic acid, acetone goes into the making of the beautiful, glass-clear, familiar plastic known as Lucite, now being pressed into service for the "greenhouses" and gun turrets of our bombers.

At the present time a most important wartime application of acetone is in the manufacture of smokeless powder for which purpose large quantities are used.

Butylene, in a similar manner, is converted into butyl alcohol and methyl ethyl ketone. The latter compound is used extensively in the de-waxing of lubricating oils, in making lacquers and artificial leather and as a solvent in applying many resins and plastics in their finished forms.

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ENGINEERING

Wind Tunnel Has Huge Induction Motor

A 40,000-HORSEPOWER electric induction motor drives air through the great wind tunnel at Wright Field. Not only is it the largest beast of its kind, but also the best tamed.

It is part of a large group of powerful machines required for the proper operation of the tunnel. Among these are a 38,000-horsepower motor-generator set, another of around 8,000 horsepower, a 400-horsepower exciter set, 6,900-volt and 460-volt switch gear, great cooling fans, oil circulation pumps, electronic control apparatus and other instruments.

The fine speed regulation of the great motor, the harmonious coordination and control of all the rest of the machinery, and safety of operation, are the problems discussed by Robert R. Longwell and M. E. Reagan of the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., at the meeting of the American Institute of Electrical Engineers in Chicago.

The operation and control are as far as possible automatic. A few manual operations are required to start the auxiliary machinery. When this is smoothly running, the operator merely sets a pointer on a dial to the desired speed. Automatically the oil pumps are started, switches are thrown, control apparatus brought into play, and the great motor is brought gradually and smoothly up to the desired speed and then held there by electronic control.

To change the speed, the operator simply moves the pointer up or down. To stop the motor, he moves the pointer back to zero.

During an airplane test, the speed is maintained constant to within 0.3% to 0.5%.

One reason for describing this installation, the engineers said, was that the same principles can be applied wherever large powers must be very accurately controlled, or many machines must be coordinated to do their proper tasks at the proper times. Thus the engineers cooperate also in helping each other.

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Visits by parents and handling of babies by nurses and interns are encouraged at one large hospital, to help overcome the *loneliness* which infants ordinarily experience from being left alone too much.