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Creators: Rickels, James W.

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Oil For Victory

James W. Rickels, Engr. II

For want of some oil, a bearing was lost;
For want of a bearing, an engine was lost;
For want of an engine, a tank was lost;
For want of a tank, a battle was lost;
For want of a battle, a democracy was lost—
And all for the want of a film of oil.

Perhaps the above lines are familiar to many of the readers. Time has proved them to be true, and quite possibly, the fate of the world will be decided by the "want of a film of oil". When oil is mentioned, the first thing that the man in the street thinks of is its use as a lubricant. However, the term, as it will be discussed in this article, will cover motor fuels, lubricating oils, greases, and cutting oils. All are prepared from the crude petroleum and each one plays its part in the industrial and military machines of peace and war.

It takes gasoline to run an army truck, or an airplane. This gasoline can be prepared by several methods. It can be made by the refining or cracking process of petroleum, by the low-temperature distillation of coal, and by the recovery from natural gas. We find that the gasoline most frequently used is the "natural gasoline". Owing to the enormous production of gas in many oilfields, and the beneficial properties of natural gasoline, methods of recovery were quickly developed, and nowadays natural gasoline is recovered even from gases containing small percentages of this constituent. There are many factors which influence the petrol or gasoline content of natural gas. Gas in intimate contact with crude oil is saturated with the different constituents of the latter. In general, if the crude oil contains a high percentage of spirit, the gases will be rich, while with heavy gravity crudes the percentage of gasoline will be small. The percentage of petrol in a crude oil may vary from a trace to as much as sixty per cent in special cases, consequently the petrol content of a crude is an important variable in determining the richness of a gas which accompanies it. Other factors influencing the gasoline content of natural gas are the intimacy of contract between the gas and the crude oil and more important still the gas pressure in the oil sands. In wells flowing naturally under very high pressure, natural gas may consist solely of methane, nitrogen, and carbon dioxide. As the wells continue producing oil and the pressure consequently diminishes, the percentage of gasoline in the gas increases. It should be realized, however, that the change of pressure merely alters the percentage of vapour in the gas and not the total quantity of gasoline existing in the state of vapour.

In Germany, as oil is not produced, the gasoline and the lubricating oils must be prepared by the distillation of coal. In fact, the most crucial oil shortage the Nazis now face are shortages of high-octane gasoline and even more, of lubricating oil for the many Panzer divisions. Although German synthetic experts can squeeze oil out of coal, they cannot in turn get nearly enough high grade oil out of the synthetic crude. The Nazis can produce 90-octane gasoline by use of tetra-ethyl lead, the ingredient that gives high octane rating to "special" automobile gasolines. But the United States, using a petroleum by-product called alkalyte, can easily produce 100-octane gasoline. Used in British and American planes, 100-octane fuel gives their engines twenty per cent more horsepower per gallon than the 90-octane German gasoline, a very appreciable advantage.

Lubricating Oils

In order that a machine or mechanism can run smoothly, it is necessary that all friction be minimized. For this purpose, a lubricating oil is used.

The function of the liquid lubricant is two-fold. First, at high speeds it must act as a supporting or cushioning medium between the rubbing surfaces, keeping them from actual contact and substituting the internal friction of the lubricant for the solid friction of the surfaces. The factor which determines the suitability of a lubricant for this purpose is its viscosity. On this property will depend the ease with which a pressure film is formed and the amount of power lost in this film once it is formed. Obviously, a highly viscous oil will form and maintain a film more readily than one of low viscosity, but it will also cause a greater power loss than a thin oil because of its high internal friction. It is best to select the least viscous oil which will prevent undue heating. The second function of a lubricant is to meet the demands of low speed and high pressure—conditions corresponding to those encountered whenever any bearing system starts or stops. In such a case, the speed is not high enough to induce the formation of a pressure film. The persistence of any lubricant between the bearing surfaces under load must be attributed to a specific property of the lubricant which causes it to resist expulsion from the interface by pressure. This specific property is known as lubricity or oiliness and is defined as that property which causes two lubricants to give different coefficients of friction when their viscosities at the film temperature and all experimental conditions are the same.

When a bearing system is insufficiently lubricated, the friction among the bearings disintegrates them and the bearings are said to be "burned up". In turn, the entire motor of the machine or automobile may be scorched or burn out of shape.

Greases and Cutting Oils

Other important petroleum products are the petroleum greases. For slow speed or high pressure conditions, such as prevail in most gear systems, or for those which involve exposure to high temperature, semi-solid lubricants are employed. These include the lubricating greases, which are made by mixing various soaps with oils of only moderate viscosity. The making of greases is an art, rather than a science, and while the general principles are known, the minor points of manipulation, which to a great extent control the nature of the products, are carefully guarded. What are known as "cup greases", suitable for low-temperature conditions, consist of mixtures of calcium soaps made from tallow, animal oil or cottonseed oil, and mineral oils of viscosity varying from 100 to 200 seconds Saybolt. This consistency of the grease will vary with the soap content, ten to twenty-five per cent of the latter being common. Gear greases are usually mixtures of very heavy oil and sodium soaps. Axle greases are very often rosin-lime soap greases containing excess lime to serve as a filler. For better products, graphite or talc is used as a filler. All greases belong to the class of plastic lubricants, and are not readily squeezed out of an interface. They are thus suited for heavily loaded bearings, while the high friction losses which their use entails, renders them unsuited for the lubrication of fast-moving machinery.

A very interesting class of special lubricants are the substances used for drilling, thread cutting, and similar lathe and machine work. Two functions may be required of these cutting oils, as they are called. First, the dissipation of heat generated in the work, and second, the maintaining of a lubricating film between the cutting tool and the material being removed. Where the former only is needed, water or alkaline solutions are effective. When cooling and some lubrication are needed, emulsions of oils of medium viscosity in water, stabilized by soaps, are employed. Better lubrication is provided by increasing the proportion of oil emulsified. When the cooling requirement is not serious, and the work is heavy, straight mineral oil, mineral oils compounded with lard oil, or, in a few cases, unmixed lard oil, may be employed. When heavy cutting is going on, a lubricant possessing an appreciable degree of oiliness is required.

Synthetic Oil

Up to this point, we have supposed that we have the crude oil necessary to refine into the products such as gasoline. However, suppose our supply of petrol is exhausted, as is also our supply of liquid fuel. During the last Great War, the essential need of an internal source of liquid fuel to a nation in time of stress was demonstrated beyond question, and the motive which is now urging the nations of the world to seek some cheap substitute for petrol or other liquid fuel from their own resources is, undoubtedly, the necessity, due to the war, of being independent of foreign supplies. Much has been said regarding the possible limited reserves of crude petroleum and various estimates have been made concerning the period of time for which these reserves will suffice, after which alternate supplies will be required; but although no mineral deposit can last indefinitely if it is constantly being used up, no evidence has been brought forward to show that crude petroleum supplies will not be sufficient to meet the demands of the next five hundred years at least. Vast areas of the earth's surface have not yet been prospected for oil and, undoubtedly, enormous stores of petroleum are still untapped. The various methods proposed for the production of synthetic fuels have, during the past few years, received severe setbacks through the prevailing low prices of the natural supplies, but more recently they have received substantial encouragement by the envelopment of the world into a state of total war and the dire necessity of some countries for a substitute for oil.

In Engand, the utilization of coal has naturally received the greatest attention in this field and various low temperature carbonization schemes have been launched; hydrogenation has also received considerable attention. In Europe, the position is rather different, and here the depressed state of the agricultural industries has caused attention to be particularly focussed upon the utilization of ethyl alcohol. This ethyl alcohol, produced from potatoes, is used as a fuel for internal combustion engines. Numerous European countries had passed, previous to this war, the requisite legislation whereby the addition of home-produced alcohol to imported petroleum motor fuel was insisted upon by law. This afforded a considerable subsidy for agriculture. As early as the seventeenth century, it was known that oil could be obtained by distilling coals and shales, but it was not until much later that the process was placed on a commercial basis. Oil shales are very widely distributed throughout the world and although they have only been worked in a few places, notably Scotland, France, Manchuchuo, Estonia and Australia, they constitute an important world reserve of oil. It is from the shale deposits of Manchuchuo that Japan gets much of her oil. Africa has shales in Southern Rhodesia, Transvaal, and Natal, some of which, e.g., those at Ermelo in the Transvaal, give oil yields as high as sixty gallons per ton and are now being commercially exploited. Extensive shale deposits occur in Europe. In France, the most important oil-shale deposits are at Buxiere and St. Hilaire and at Autun. The oil-shale industry of France dates from 1830. With the exception of the United States of America, Russia has the most extensive shale deposits in the world. These have hitherto been used for heating purposes, but shale utilization in gas, gasoline, and asphalt production has been progressing recently on a large scale. Oil shales do not contain oil in the free state. They contain a complex organic material often referred to as "Kerogen" or pyrobitumen, which on heat treatment is decomposed and oil is liberated. This crude oil is very similar to crude petroleum as far as its constituent oil fractions are concerned.

In the decomposition of the shales by heat treatment, several stages can be distinguished. It is believed that first of all the kerogen decomposes to give a bituminous material insoluble in organic solvents, then a soluble bituminous substance is formed, and finally, this is decomposed into oils of wide boiling range and permanent gases such as methane and hydrogen. The production of hydrogen and permanent gases together with unsaturated gases, occurs during the thermal decomposition (i.e., cracking) of the intermediate bitumen. Regardless of the exact mechanism of the conversion of kerogen into oil and gas, the process is fundamentally the decomposition or cracking of heavy and complex molecules to simpler ones. It is possible to control the process in various ways so that, for example, the relative proportion of oil and gaseous product can be varied. It has not yet been possible to suppress the formation of the considerable quantities of gas generated in this process. So much for the shale oil. Another reserve of oil which must not be overlooked is the huge quantity which remains in an oil-sand, after gas and other pressures have caused the wells to cease to flow. If these sands are near the surface, mining operations can be resorted to, in order to drain the sands further. Methods of freeing oil from oil-sands by flooding the fields with dilute alkaline solutions have been attempted. There also occur, in certain localities, sands which are impregnated with heavy bituminous material, which may be the remains of petroleum deposits. Such deposits are known as Bituminous or Tar Sands and those in northern Alberta, Canada are the best known. These sands contain from seven to twenty percent by weight of a heavy asphaltic oil. The following methods have been suggested for the separation of the sand and the bitumen:

1. Distillation in retorts by external heating or partial combustion of the bitumen itself.
2. Treatment with combustion gases, steam, or hot water.
3. Treatment with solvents, such as petroleum distillates.
4. Treatment with acid, such as dilute sulfuric acid.

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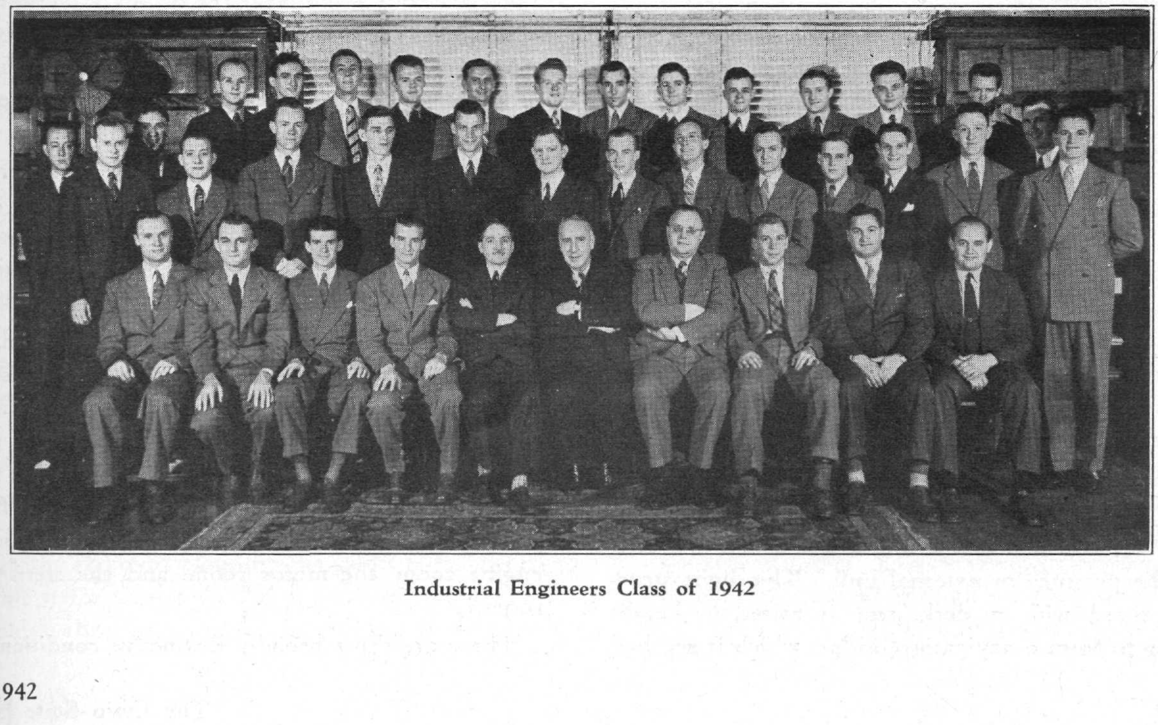

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5. Treatment with solutions of sodium silicate, alkalies.

Other oil reserves and synthetic sources of oil may be found in coal carbonization, which is the decomposition of coal by heating. Inflammable gas, tar, and an aqueous liquor are given off and the residue is coke. It is from the tar that the oil is finally produced.

Having briefly covered the important divisions of the oil industry set forth at the beginning of the article, it might be in order, in closing, to give a general picture of the world's oil. So suppose that we take a quick journey around the globe and observe just where the oil for today's war is located. In the Western Hemisphere, we find seventy-six percent of the world's crude oil production, and seventy-eight percent of the world's refining capacity. Of the former, this amounts to 1,762,000,000 barrels and of the latter, 1,990,000,000 barrels. As of the present, there is no appreciable amount of synthetic oil production in this part of the world. Aruba, in the Carribean, is the world's largest refining center with a capacity of 285,000 barrels per day. It serves the rich Venezuelan fields and is set up to produce high-octane gasoline in quantity.

In Axis Europe

Crude oil production	54,000,000 barrels
Refining capacity	190,000,000 barrels
Synthetic production	45,000,000 barrels

Axis Europe feeds all of its oil to the German war machine. Germany's synthetic industry produces almost as much as Europe's oil fields, the largest of which are in Rumania. Great Britain produces no oil at all.

In the Near East

Crude oil production	312,000,000 barrels
Total refining capacity	360,000,000 barrels

The U.S.S.R. gets most of its oil from the Caucasus region between the Caspian and the Black Seas. In Siberia, the Soviet has secretly drilled wells, built refineries whose exact capacity can only be guessed. Abadan, in Iran, is the second largest refining center in the world with a capacity of 280,000 barrels per day. It serves the fields of central Iran and the oil-soaked island of Bahrein on the Gulf of Persia. India used to receive oil from the Burma fields, but this source has been destroyed by the English before the invading Japanese.

In the Far East

Crude oil production	84,985,000 barrels
Refining capacity	105,000,000 barrels
Synthetic production	10,000,000 barrels

In this part of the world, we find that China produces no oil worth mentioning. Australia produces a tiny amount of shale oil, and has to import the rest. Japan has hardly any oil of her own. To make up for this deficit, she has fostered a sizable shale industry in Manchuchuo and also built up huge stocks from imports. The Netherlands East Indies are now in the hands of the Japanese. Despite destruction by the retreating Dutch, Japan is said to be already drawing from these fields.

Such are the oil conditions of the nations of the world engaged in war. Even after having lost the big Far Eastern fields, the United Nations still control ninety-three percent of the world's crude oil, eighty-eight percent of its refining capacity, and nearly ninety percent of its tanker tonnage. In two normal weeks, the United States alone can produce enough oil to keep Japan going for a whole year, even in war time. The California oil fields, which are not nearly so large as the Texas fields, gush out more oil than the wells and synthetic plants of Europe.

From New York, New Orleans, San Francisco, Los Angeles, Galveston, Aruba, Valparaiso, and Buenos Aires, tankers are slogging through the rough waters of the Seven Seas. The tanker, ever fearful of lurking submarines, churns forward through the treacherous seas with its precious cargo of oil—oil for the thirsty planes, tanks, and ships of the Allied Nations—oil for victory!

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