The Oil That Makes the Wheels Go 'Round

Animal and Vegetable Lubricants vs. Those of Mineral Origin Today and in the Future

By Harry A. Mount

ATTENTION has often been called to the fact that our decreasing production of petroleum menaces a vital fuel supply and it has further been pointed out that we are dependent upon this source also for lubricants without which modern industry would be quite as helpless as though without fuel.

Much concern has been expressed over the fuel situation, principally because those who own motor cars (and they comprise a large part of the population) have already felt the pinch of scarcity. But, as a matter of fact, the fuel problem is not without its brighter side, while that of a future supply of lubricating oils, in many of its aspects, is much more serious.

It has been demonstrated that we need not wait while buried vegetable matter goes through countless ages of transformation before there is available the fuel we derive from petroleum. Nearly any growing plant, when subjected to a simple process of fermentation and distillation, yields a fuel, alcohol, which when properly prepared is as good as gasoline, or even better, as a fuel. But is not the same thing true of lubricants? What of the great variety of oils and greases which are now obtained directly from plant growths and are used as lubricants, such as castor oil, rape seed oil, etc? And then, there are the animal oils and greases, such as lard oil.

Aside from the fact that all oils look and feel very much alike, there is hardly any similarity between vegetable and animal oils on the one hand, and mineral oils on the other. They are utterly dissimilar in chemical structure and physical properties. Mineral oils are hydro-carbons, while animal and vegetable oils are glycerides, composed of fatty acids and glycerine. In most cases where vegetable or animal oils are used for lubrication they are simply added to a mineral oil base to give it certain properties desirable for some specific use. The total volume of vegetable and animal oils used as lubricants is very small as compared with mineral oils and the percentage is steadily decreasing. We are absolutely dependent upon mineral oils to keep the wheels of industry turning smoothly.

The difficulty with vegetable oils (animal oils possess the same properties but are used very little for lubrication and need not be considered here) is that they all have in varying degrees properties which, while very useful in other applications, render them useless for most lubricating purposes. The most troublesome property, no doubt, is the tendency to dry out or oxidize. Certain elements of all vegetable oils unite with oxygen from the air, releasing fatty acids which are injurious to steel and leaving a residue or "gum" that must be cleaned away. The oil which lubricates your typewriter, for instance, should be a pure mineral oil if "gumming" is to be avoided.

Other troublesome qualities are those of saponification and emulsification, terms very often confused. Saponification is a simple chemical reaction whereby the oils are split up and recombine with metals, generally those belonging to the alkali group. These combinations of the major portion of the oil molecule with the metal are called soaps. The soaps of commerce are generally produced by treatment of a fat or fatty oil with caustic soda or potash, but saponification may also take place in the presence of calcium, aluminum and lead.

Then, all petroleum oils may be induced to emulsify if mixed with vegetable oil, but pure mineral oils do not possess this quality. Emulsification is a purely physical action, being the mixing of oil with water to form an emulsion. The milky liquid used in machine shops to cool the tools of high speed lathes and similar machines is such an emulsion. Some vegetable oils will emulsify by simply mixing with water, while others have to be violently agitated or in some way atomized. If a pure mineral oil and distilled water be placed in a bottle, however, and the mixture agitated and then allowed to settle for a few seconds, both liquids separate with a sharp surface demarkation and are clear. They cannot be made to mix.

The remarkable thing about emulsification is that while water will suspend a considerable quantity of soluble oil without an appreciable change of viscosity, if more and more oil is added, a point is suddenly

reached where the solution thickens to the consistency of a solid. If this process is reversed, that is, if the water is added to the oil, this degree of solidity is reached very quickly. If a vegetable oil is used to lubricate a piece of machinery where water is liable to get into the oil a solid emulsion is formed. Advantage of this is sometimes taken in slow speed machinery. Thus it has long been the practise to add a small quantity of rape seed oil to the mineral base used in lubricating marine engines. The water from condensing steam forms a solid emulsion and this causes the oil to stick better to the guides, piston rods, blocks, etc., of the engines. But wherever high speed turbines have replaced the lumbering reciprocating engine the practise has had to be discarded in favor of a pure mineral oil.

These same qualities which make vegetable oils undesirable for lubrication render them invaluable in many industries. The largest use, of course, is in soaps and paints. Many varieties of oils and greases, from olive oil to fat offallings, are used in making soap.

The requirements for paint are more exacting. A good paint oil must be quick drying, and for this purpose linseed oil is used almost exclusively because it is the fastest drying of all oils. Attempts to use mineral oil in place of linseed oil in paints have given no encouragement to the experimenters. A paint consists essentially of a pigment or coloring matter and a vehicle for applying, and a thinner, as turpentine or a substitute made from petroleum. The solvent, when it dries, must leave behind some solid matter for holding the pigment and to form a protective coating. A mineral oil vehicle simply soaks into wood when applied and the first rain washes away the pigment.

LAST year and the year before, when we were all so concerned over the apparently imminent exhaustion of our petroleum deposits, the chief concern was felt with regard to the fuel of the future for internal combustion engines. Comparatively little attention was paid to the fact that not alone the automobile, but all engines and machinery of every description, are largely dependent upon petroleum derivatives for lubrication. Now that the price of gasoline is declining so steadily and even so rapidly, we are apt to think that all the problems connected with petroleum production are permanently solved. That this is not the case, that it is necessary for us to pay serious regard for the future supplies of lubricant, is Mr. Mount's text in the story on this page.—THE EDITOR.

Certain vegetable oils are regarded as essential to other industries and they are used in very large quantities. For instance, in the silk industry, olive oil soap is used to saturate the raw fiber before putting it through the various mill processes. This renders the fibers more pliable and lubricates them so that they slip easily, preventing breakage and generally facilitating all of the processes. Other cheaper oils are used for the same purpose in the wool industry.

Castor oil is an essential material in the manufacture of artificial leather and in the curing of some grades of real leather. Certain vegetable oils have become important articles of food, such as olive oil and cotton seed oil. Others, as coconut oil, enter in large quantities into the manufacture of other foods. Indeed, the minor uses of vegetable oils are myriad and they enter into thousands of articles of every-day use.

Castor oil represents the only apparent contradiction to what has been said. It is regarded by some engineers as essential to the lubrication of certain types of high-speed internal combustion engines, notably the rotary type of aviation motor. Some automobile racing drivers also favor the use of castor oil. There is a wide divergence of opinion here, however, and on some of the aviation fields of this country during the war mineral oils were used exclusively with satisfaction in all types of motors, even though castor oil was available.

Castor oil was first used in this way in the rotary motor for two important reasons. This motor draws its gas through the crank case and because of the affinity of mineral oils for gasoline, trouble was experienced from the "soaking up" of the gas by the oil and thinning the lubricant. It is almost impossible to mix castor oil and gasoline and for this reason no trouble

is experienced from this source. The second reason is that, while castor oil is thinner at normal temperatures than the heavy oils usually required for air-cooled motors, at very high temperatures it is thicker and therefore a better lubricant. The oil in aviation motors is changed after a few hours of use so that there is not time for the undesirable features of the vegetable oil to show. Attempts to manufacture a motor oil for automobiles from castor oil, or with castor oil as a base, have generally proved unsuccessful because the oil is used for a longer time, allowing the natural reactions to set in. In addition, mineral oils are better suited to the comparative low speeds and low temperatures of automobile motors. As one engineer puts it:

"If an automobile could be kept going at sixty miles an hour and if the oil were changed at the end of every day or two, castor oil would be all right. But under ordinary driving conditions I do not believe we will ever be able to get away from the natural undesirable features."

Another reason that many motorists have been led to believe that castor oil would some day prove a panacea for their lubricating troubles, is the general air of mystery that has surrounded the subject. There are in this country only a few firms extracting castor oil and the rivalry between them is intense. The secrets of their plants are closely guarded.

But during the war when there was need of large quantities of castor oil the Government erected a plant at Gainesville, Fla., and after many disappointments and failures was able to refine a castor oil of commercial quality. The conclusions reached in this experiment have been published by the United States

Department of Agriculture. The process roughly was first to clean the beans, heat them, press out the oil in a continuous process and then to treat the meal with benzol to remove the final traces of oil. Great difficulty was encountered in adapting machinery to the purpose and in developing a working technique.

The results were disappointing from the standpoint of quantity but this was largely because a crop of castor beans, the standpoint of quantity, but this was a failure. The castor bean industry is an important one in India and most of the beans used here are imported from there. The seed for the war crop planting came from India but because it was not acclimated the yield was only a fraction of what was expected. We have

lapsed into our pre-war state in the matter of growing castor beans and aside from a few plants which are not uncommon as lawn ornaments, none is grown in this country.

It will thus be seen that castor oil is no exception to the general rule that vegetable oils and mineral oils each occupy a definite field of usefulness and that while they overlap to some extent there is no hope that either can take the place of the other.

There is no immediate famine in lubricating oils. Because of the large production of gasoline there is, in fact, an overproduction. This is because the same barrel of crude oil which yields the gasoline, also yields in the refining process a percentage of heavy oil. Indeed, it is now the practise to extract more gasoline from the crude by applying to the lubricating oil a "cracking" process, leaving as a final residue only a small quantity of coke.

It is not beyond conception, however, that if gasoline is displaced as a motor fuel, as indeed it must be, there will be a decided change in the economic status of lubricants, if not an actual famine.

An economical process for recovering oil from the vast shale deposits would afford relief for many years, even after the exhaustion of petroleum, but beyond that there is no substitute in sight.

Neon Lamps in Agriculture

DURING the year 1916-1917 the Horticultural Institute of Berlin-Dahlen made a number of experiments with respect to the effect of illuminating fields of tomatoes and of gherkins by neon lamps. According to *La Nature* (Paris), the surprising yields were obtained of more than 41 per cent excess over the normal for gherkins and 40 per cent for tomatoes.