THE PART OIL PLAYS IN INDUSTRY

By A. P. COLLINS

Most of us today are aware, even if only vaguely, that oil is one of the commodities which is essential to our civilisation. During this last World War its importance was equal to that of machines and munitions, yet we accept its existence without question and almost without interest.

I shall endeavour, in this discussion, to tell the story of how petroleum, as the oil man knows it, is obtained and the part that oil, which is one of the many products which is extracted from it, plays in the pattern of industry.

For centuries man has known that certain substances when applied to a point of friction enable him to use less energy and help to keep the temperatures of the working surfaces low. Animal and vegetable oils and fats were for many years the major source of lubricants and even today the modern petroleum chemist uses ingredients such as wool-grease and tallow, sperm, castor and rape and many other oils in his blends. Almost certainly the first petroleum product to be used by man was bitumen; ample evidence still being available in such places as The Hanging Gardens of Babylon, and Marco Polo reported the "oil springs" of Baku on the Caspian towards the end of the thirteenth century. This petroleum residue was obtained from naturally-occurring seepage from which the lighter fractions had evaporated and it is a fairly safe bet that the charioteers of old Rome used a bitumen-based compound as an axle lubricant. It was not until Drake had successfully drilled the first oil well in 1859 in Pennsylvania that a serious attempt was made to obtain commercial quantities of crude oil from the earth.

It is generally accepted that oil has its origin in the decomposition of animals and plants known as foraminivera, which are buried under successive layers of mud on the bed of the sea, in some cases as many as four hundred million years ago, and transformed by chemical or bacterial action. Time and pressure turned the layers of mud into rock and the oil was squeezed out. By migration through the more porous types of rock much of the oil percolated to the surface and was lost, but volcanic upheaval in some places caused these accumulations of oil to be trapped in large pools under a layer of impervious strata. It is into these trapped pools that wells are drilled and the crude oil is forced up to the surface under its own pressure or when this fails it is assisted by pumping.

An estimate of the total consumption of petroleum in 1956 by the free world is six hundred and ninety-four million tons and in order to ensure that the ever-increasing demand can be met, exploration proceeds continuously. Modern methods include surface examination by aerial photography, the use of aerial magnetometers, which are trailed under an aircraft in flight and record changes in the earth's magnetic field, and the older methods of trigonometrical and geological surveying. Today, too, the seismograph (which is an instrument used to plot the position of subterranean rock strata by shot and echo-sounding) is also widely employed.

Refining of the crude oil enables the oil man to separate out the various fractions, as they are known, into a variety of fuels such as petrol, paraffin, diesel and fuel oils, a range of lubricating oils and finally paraffin waxes and bitumens. Numerous by-products provide further raw materials for the chemical field, which is in itself a complete industry.

Thus we see that in merely obtaining the raw materials the oil industry itself calls upon many other fields of industry. However, our interest today lies in how the oil itself dovetails in with the industries which use it.

Let me tell you of some of my own experiences as a representative of one of the major oil companies here in Natal and which will serve to illustrate this relationship.

I shall start with examples from the motor industry.

Many times I have had the experience of being among a group of people with widely differing interests—the conversation lags. Then someone passes a comment about a new model car. Immediately everyone present becomes surprisingly interested and doctors, lawyers, clerks and engineers speak with apparent authority on the merits or otherwise of a particular vehicle. It is at these meetings that unfavourable gossip travels like wildfire so that it is not surprising that the motor car manufacturers, well aware of the speed at which bad news travels, call upon anyone who can assist when unforeseen troubles develop.

Recently, due to the efforts of the maker to squeeze just a little more out of his machine, certain faults such as excessive camshaft or cam follower wear have taken place. In order to overcome valve bounce valve spring pressures have been increased and the materials hitherto used with every satisfaction have suffered, in some cases, from severe scuffing. The fault can, and has been, eliminated by an improvement in the alloys used, but meantime the particular model has been built and some thousands are already in the hands of the customer. Here, then, is an occasion when the oil technologist is able to assist in no small way. In this particular instance the incorpora-

tion of a compound known as zinc dithiophosphate into the lubricating oil was able to reduce the scuffing and many modern automotive crankcase oils contain some such agent. The original problem has now been solved by the metallurgist but the oil industry was able to avert what could have been a catastrophe.

Multi-grade oils, with which many of you are by now quite familiar, also play their part in assisting the automotive industry and wear rates can be considerably reduced by their use, although I must emphasise that these new oils perform other functions as well.

Transmission systems have been receiving the attention of the oil industry for some years and the development of special green gear lubricants has enabled the successful mass production of hypoid gears which previously were a manufacturing bottleneck due to the complex machining necessary to provide a suitable surface finish. These new lubricants now provide a protective film which enables the gears to develop the required surface during the running-in period of the vehicle's life.

Sometimes new designs pose some real headaches, for the oil industry, and one such occurred recently with the introduction of a new car which has a completely hydraulic suspension system. As the temperature of an oil is raised so its viscosity decreases and this would have meant that the spring rate of the suspension would have altered to an undesirable point after the vehicle had been driven a few miles and the oil had warmed up as a result of the changing pressures applied to it by road surface irregularities. An oil with a very high viscosity index was required i.e. an oil whose viscosity altered far less with changes of temperature than is normally the case, and an oil with a V.I. of no less than 160 was produced to meet this requirement. Furthermore this new oil has no detrimental effect on rubber or aluminium, a condition which is obviously essential where such products are being used in contact with it.

The tubeless tyre, which depends for its successful operation on the close fit between the tyre and wheel rim, is very often something of a problem child to those who are employed in fitting it. Here, too, oil has been able to play its part and the oil industry has recently developed a rubber lubricant containing among other things graphite and water, but which has no materials harmful to rubber.

The ever-increasing desire on the part of the designer to get more out of less has posed problems in the design of turbines, particularly in those of marine installations. Greater power output and the ever-present necessity of having to economise on space, have thrown additional loads on modern marine gearing and to the present range of turbine oils, many of which used in big installations are guaranteed for the life of the plant, has now been added a new series containing extreme pressure agents designed to eliminate scuffing in new turbine gears.

The use of oil as a lubricant is something with which all of us are familiar, but as an example of a lesser known application it is interesting to note that considerable quantities of light lubricating oil are necessary in the process of manufacturing rope. In most textile spinning or rope manufacturing operations a batching oil, often made up in the form of an emulsion, is applied to the fibres to enable them more readily to be handled by the machinery. Not only are the fibres softened and made more pliable by this process but additionally at the high speeds at which modern spinning takes place undesirable temperatures would occur in the raw material if some lubricant was not used. A large rope manufacturer can conceivably consume something in the neighbourhood of three to four rail tankcars of lubricating oil in one month alone for this purpose.

Most of us have experienced the delightful cushiony feeling of the new foam rubbers, but how many of us know that in order to make this product, once again oil is a necessary ingredient, and rubber plasticizers are an important part of the process oil trade. In fact while we are dealing with process oils the very ink with which this address is printed also requires the admixture of oil in its manufacture.

One of the things which I dislike doing more than any other is that of having to take medicine, and of all medicines I think that castor oil and liquid paraffin are probably two of the worst. Castor oil is, of course, not produced by the petroleum industry but is used widely by it, and I shall deal with that in a few moments. Liquid paraffin, on the other hand, is a direct derivative of petroleum which is very highly refined to British Pharmaceutical Standards and is often recommended, apart from its laxative properties, as a lubricant in food-mixing machinery and also as a preservative for eggs. Most sugar mill engineers will have at one time or another used castor oil as a means of getting out of trouble when a hot bearing occurs, and its lubricating properties are undoubtedly of a very high order. The petroleum engineer, called upon to solve a ticklish problem involving the lubrication of rear axles of heavy-duty vehicles, finds castor oils an exceptionally useful ally. However, they must be used with discretion. During the first World War the reek of burning castor oil must have been familiar to many who were in the Royal Flying Corps, for castor oil was commonly used to lubricate the old Gnome Rhône Rotary engines of that day. However, those of you who have used it will recall that after a comparatively short life it polymerizes into a sticky, gooey mess and it is this tendency on the part of castor oils to oxidize that poses yet

another problem to the lubricants engineer. However, research and development have enabled him today to produce an oxidation-inhibited castor based oil which has proved outstanding as a lubricant for worm-drive rear axles.

Most modern motor cars today are fitted with hydraulic brake systems and brake fluid itself is simply a mixture of castor oil and alcohol. Incidentally, one of the most important characteristics of a brake fluid is that it should have no deleterious effect on natural rubber components, and stringent precautions must be taken to ensure that no contamination by a mineral oil product occurs. Industrial hydraulic systems frequently present their own problems, not the least of which is foaming of the hydraulic medium, and where oil is used as this medium it is common practice to employ the use of some anti-foam dope. Silicon fluids are often used for this purpose and you will appreciate how powerful is their action when told that it is usually necessary to add only a few parts per million of such a fluid to the base oil.

It is not always the demands of industry which cause the oil man to produce a better product, for he is continuously trying to improve upon that which has already been produced and sometimes we meet with a leapfrog effect between the manufacturer on the one hand and the oil technologist on the other. Electrical insulating oils a few years ago fell into this category. In an effort to prolong the useful life of oils in transformers, oxidation inhibited oils were produced. However, certain transformer manufacturers were quick to realise that by using these oils they could redesign their equipment, taking advantage of these new products and making their transformers both smaller and lighter. That by so doing they shortened the useful life of the oil was apparently of no concern. However, this example serves to show that there are occasions when developments in petroleum technology enable the manufacturer to improve his product in turn. If in the examples I have just quoted the emphasis seems to have been laid on the relationship between the oil industry and the original manufacturer of the equipment which uses oil, it is only because these manufacturers have been quick to realise the value of the services that can be rendered by the oil industry, and I should like to point out that a great deal of information which could enable the oil research worker to develop or improve his products can and is obtained from the user in the field and not infrequently manufacturers' original oil recommendations or specifications are amended from time to time in the light of further field use.

The subject of corrosion prevention is a good example of a case where co-operation between the man on the spot and the oil representative can between them supply valuable information to the research worker, enabling the industry to provide better and more useful products. Here in Natal, particularly along the coastal stretches with their high temperatures and high humidity, rust undoubtedly takes heavy toll of steelwork which has been left unprotected, and it is no uncommon sight, just prior to the commencement of a new crushing season, to see gangs of natives, equipped with emery cloth and paraffin, rubbing down machine parts in an effort to restore their original lustre. It is no trick on the part of any oil technologist to provide temporary corrosion protectives which when correctly applied, result in the saving of much wasted manpower.

Summary

It is only by co-operation between consumer, manufacturer and supplier that progress can be made and we in the oil industry are only too fully aware that the part played by oil is such that industry could not exist without it, but that on the other hand, without industry there would be no need for oil.

Mr. Rault wanted to know what "scuffing" meant.

Mr. Collins said it was a loose term used to describe the result of metal to metal surface wear where the oil film had broken down. It usually appeared in the form of a scar or scars.

Mr. Hastilow wanted to know Mr. Collins' experience on the use of molybdenum disulphide.

Mr. Collins said molybdenum disulphide had been used in the oil industry for some time, such as in special service greases for turbines. It was essentially a boundary layer lubricant, as is graphite. In cases where the ordinary oil film can be maintained, there is no use for molybdenum disulphide, but where this film breaks down it would be useful. It has a very much higher co-efficient of friction than the normal oil film. The tendency, therefore, is to keep it out of the picture. It has a useful part to play in conditions of boundary lubrication and also in cases such as just before closing up mill journals, to cover the time in which a journal has no oil protection and until the oil film is properly established.

Mr. Rault said that the chemist in the sugar factory was often called upon to test limestone, coals, coke and the like and he wanted to know if there were any tests which could be used to examine the quality of oils used in the sugar factory.

Mr. Collins thought that this could receive attention as the oil industry was sometimes called upon to perform, perhaps unnecessarily, analytical tests such as water content. This could be done in the sugar industry laboratories and he thought the oil industry would welcome such liaison between the oil chemists

and the sugar chemists. It was, however, part of the oil company's service to carry out these routine analyses.

Mr. Hastilow referred to the quarternary ammonium salt/bentone compounds which he thought could act as lubricants, and wanted to know if Mr. Collins could throw some light on their use.

Mr. Collins offered to supply the required information later.

Mr. Bentley said he had heard that plastics, as a bearing material, are likely to come to the fore and he would like to know if such a development was likely to take place.

Mr. Collins said that the development of plastics had only become possible through the chemical side of the oil industry. Polyethylenes, for instance, are derivatives of petroleum oil, so that one could consider plastic bearings also attributives of the oil industry. As far as their lubrication was concerned, some bearings in ships, which used synthetic bearings, and consisting of an oil impregnated linen, were lubricated by water.

Mr. Narbeth referring to lubrication of synthetic bearings, said that Nylon bearings which do not require lubrication are available, and are invaluable when lubricants cannot be used for fear of contaminating the material handled. For example at Sezela the screw conveyor which withdraws the refined sugar from the classification bins, is fitted with Nylon bearings which do not need lubrication. These bearings have proved quite satisfactory in service.

Mr. Collins said that synthetic bearings do not always require a lubricant. Sometimes oil was used as a corrosion preventative and not as a lubricant itself.

Mr. Rault enquired if it was good practice to put oil in the petrol of a motor car.

Mr. Collins said that the addition of oil to petrol was common practice in two-stroke engines. However, if oil was used in petrol as an upper cylinder lubricant, it would appear that there was not much material benefit to be gained. The addition of oil to petrol must tend to form additional carbon deposit and this might actually cause harm, particularly owing to the clogging of piston rings.