Castor Angles - The Rise and Fall of Castor Oil

In its heyday, castor oil was the best engine lubricant money could buy. Not only was it used in engines, it was also recommended as a gear and transmission oil. The smell of burnt castor oil was regarded by those in the motor racing fraternity as the best smell in the world, outstripping many of the famous fragrance manufactures searching for that alluring smell that would attract man to woman, only here it was attracting men to motor sport. The early years at the birthplace of British motor sport must have been alive not only with "the right crowd and no crowding" but also the wonderful smell of castor in the air as man and machine did battle for hours on end hauling cars large and small around the concrete saucer known as "Brooklands".

But what was the situation like back then in terms of lubricants?

Early motoring footage taken at race meetings such as "Brooklands" inevitably shows the race winner, his once white overalls completely stained with oil, and the outline of his goggles upon a weary darkened face, shows that leakage and excessive oil consumption was certainly par for the course in those days, the oil itself little more than crude. Lubricants back then was of a very poor quality. They were produced directly from the distillation unit, and their physical characteristics depended very much on the type of crude oil used.

As a generalisation, lubricants of old would have been of a high viscosity, very waxy and have very poor low temperature characteristics.

With the exception of those produced from Pennsylvanian crudes they had low viscosity indices and high pour points, i.e. very heavy at low temperatures and very thin at high temperatures. With these conditions, great care was required in warming the engine or more importantly the oil before full revs could be achieved. Great care was also required in keeping a constant eye on the oil pressure gauge, a reading too high signalling low flow rates due to excessive thickness of the oil. It was said that the riding mechanics role was "not a happy one". Pennsylvania light crude oil provided lubricants with good high viscosity characteristics and good low temperature performance levels, and soon developed a reputation and the often quoted comment that "Pennsylvanian crude is the best in the world".

Aviation like motoring was also in its infancy and again "Brooklands" was Mecca with companies such as Sopwith and Avro setting up hangers, building aircraft and constantly setting records of powered flight. Lubricants again played an important part as most of the aero engines used, were largely based on small car engines being in-line four cylinder units, or in some cases V-engined.

With the outbreak of war in 1914, great strides were made in aero engine design. Largely to save weight and space, the radial aero engine was designed and built by such companies as Clerget, Gnome, Rhone and Bentley. Being a radial engine by design, these engines relied on oil to be splashed around the crank chamber and removed via the exhausts. Of course no sumps were accommodated in this design.

To this end castor oil or bean oil was primarily developed for this application. Due to the torturous nature of the rotary engine's induction system, plus the need for the oil not to mix with the fuel, castor based oils were the only products used in this design type.
It was during this era that the castor cult started.

Whether it was the smell or one had to be seen using something new, the cult of castor quickly gathered momentum in the world of motor car racing, but almost from the word "go" its use in conventional motor car engines was plagued with problems.

On the positive side, it was reported that castor based oils ran cooler. It was an old adage that castor had the ability to leach heat away from hot metal. Technically, castor based products are more polar, having a greater attraction to metal, than mineral oils, and improved heat transfer from highly loaded areas. This polarity also improved oil film load carrying ability and these beneficial features could not be matched by the straight mineral oils then available.

On the negative side there was a problem with excessive gum deposits resulting in almost continual oil changes, whilst also sharing the same problem encountered with mineral oils that being high viscosity at low temperatures and a very rapid drop of viscosity as temperatures increased. The problem of excessive gum deposits due largely to very poor oxidation stability was not an issue with radial aero engines, as in their case having a total loss oiling system the oil never had the opportunity of gumming up.

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Alexander Duckham, of Duckham Oils fame in 1912 carried out tests whereby he measured carbon deposits on pistons after 1000 miles using six different oils one of which was castor. The results showed quite definitely that castor oil produced the greatest amount of deposits and in his summing up states "that in my opinion castor oil can only be used in fixed cylinders with impunity for short distances and then with repeated cleaning between runs."

Duckham's testing and his subsequent report was soon followed up by Messrs C.C. Wakefield's response and subsequent article on their testing using a blend of castor and mineral oil combined.

"It is obviously desirable to employ a lubricant which will withstand the maximum pressure, rather than rely upon one which will maintain the surfaces apart. Exposed to heat, castor oil polymerises, that is to say, the molecules combine together and form larger ones resulting in the soft deposit found when using castor oil. Now if a wedge be placed between these molecules in the shape of a mineral oil molecule, the tendency to polymerise must of course be reduced and therefore the soft deposit be more or less eliminated. To retain in a lubricant the acknowledged virtues of castor oil without it's defects was a problem we set ourselves to solve, and by much research work were at last successful. This was brought about by blending a castor oil of great purity with a special grade of mineral oil. Normally, castor oil will not mix with a mineral oil, but the difficulties were finally overcome and the result. "Castrol" was an achievement due entirely to our research department, and what had been considered impossibility became an accomplished fact…"

Extensive field testing was carried out by Wakefield's who had engaged the services of one Louis Coatalen and his massive Sunbeam who at the time had been setting endurance records, and with his successes plus the Wakefield's publicity machine the new brand of castor oil named "Castrol" was about to change the face of motorsport.

With the introduction of superchargers, power output increased which also led to engine temperatures increasing which had a significant bearing on oil viscosity.

In the 1920's typical maximum bulk oil temperature was about 100-120 °F (40-50°C). This was increased in the 1930's to 120-150°F (50-60°C). As temperature increases, oil viscosity decreases and for a typical mid 1930's SAE 40 engine oil the viscosity drops dramatically as the temperature is increased from 45°C to 60°C (from 300cst down to 100cst). Not surprisingly oil coolers became widespread in competition engines.

The oil pressure gauge became the second most important instrument to the competitive driver, a pressure too high or too low spelling imminent disaster.

As mentioned earlier, oil consumption was a major problem both in car and aero engines, and footage of pit stops in most cases shows large quantities of oil being added to the engine. External quick release filler caps made the job a lot easier, along with oil sight gauges.

A typical competition engine in the 1930's would be a classical twin overhead camshaft layout, either normally aspirated or supercharged. It would be tuned to run on pure methanol or a methanol/petrol mixture, warmed up on soft plugs and changed over to hot plugs for the race.

Hot plugs do not like being hit by slugs of oil. One of the major sources of oil consumption in a twin O.H.C engine is down the valve guides. The overhead cam area is flooded with oil to ensure adequate lubrication. Due to its proximity to exhaust valves and the combustion chamber, this oil is very hot and thin.

Excessive valve stem clearances together with periods of high vacuum or negative boost in the intake manifold draws oil from the camshaft area onto the back of the inlet valve. This can be seen when cars accelerate out of a corner blowing considerably more smoke than when entering.

When investigating spark plug oiling in an alcohol fuelled engine, it was noticed that the problem diminished if castor based, not mineral, was used. The castor oil mixes with the alcohol and burns in the combustion chamber. Mineral oil does not mix with the fuel and plug fouling results.

In the 1930's castor based lubricants could not be matched by the unsophisticated mineral oils of the time. Despite relatively poor viscosity characteristics, considerable problems with deposit formation and minimal life both in and out of the engine it did a first class job. The formulation undoubtedly kept many engines running which would have failed if filled with a mineral oil.

When restoring and running a car from the castor based oil era, there is still a belief that despite the fact that during restoration the latest 2000's style materials have been used, the engine will only run satisfactorily on 1930 type lubricants. This is a common fallacy and not supported by facts.

There is nothing fundamentally wrong in using 1930 style lubricants in a 1930 designed engine, provided you don't mind having all the problems experienced in 1930. Castor based lubrication technology is superseded. Since the mid 1950's virtually all racing engine lubricants have been based on mineral oil formulations. The major source of so-called synthetic oil is from crude. So what are the advantages and disadvantages of using modern mineral or mineral/synthetic based engine oils in pre-world war two racing engines?

Modern engine lubricants have two major advantages over the old 1930 mineral or castor formulations.

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Viscosity Characteristics.
Due to the developments of refinery techniques, modern base oils have greatly improved low temperature fluidity. The rate of viscosity change against increasing temperature known as the viscosity index has also been improved but both ends of the viscosity/temperature curve can be manipulated by the use of chemical based additives.

Modern Additive Treatments.
As mentioned above, additives can improve the viscosity characteristics of engine oils. The low temperature end can be improved by "pour point depressants" which improve the pumpability of the oil at temperatures lower than 40°F (5°C). The viscosity of a base oil prepared with modern refinery techniques is far superior to the mineral base oil of the 30's and can further be improved with viscosity index (VI) improvers which are used to make multigrade engine oils.

When multigrade oils were first introduced in the 1950's, there was a well-known statement that "you can't make a multigrade racing oil".
Considering the state of the art and the type of chemical VI improvers used then, it was a true statement. Today's technology can however, produce a full range of multigrade oils suitable for every application. Before the correct choice can be made, the viscosity requirement and operating temperature of the engine must be checked against the viscosity provided by the lubricant. For example, a 15W-40 would be unsuitable for an engine originally designed to use an SAE 50 and operating at 50°C. At this temperature the multigrade in question would be equivalent to a very light 30 grade. Improved control of viscosity means many things to the driver. The fastidious warming up of the engine is no longer critical although care must be taken not to overload the of pump drive gears.

The problem of slowly diminishing oil pressure as the temperature rises has been virtually eliminated. Oil consumption can be dramatically reduced and is critical in long distance or racing work. This improved control of viscosity at high temperatures reduces the amount of oil leaking past the valve guides, into the combustion chamber and subsequently oiling the plugs. This will be significant using either alcohol or petrol but does raise the next point quoted by some enthusiasts that "you must use a castor based oil when using alcohol". This may have been true in the vintage era but with the use of modern high VI oils, valve stem oil seals and better machining tolerances the amount of oil entering the intake manifold can be substantially reduced. Spark plugs have dramatically improved over the past 40 years and the oiling of plugs is now almost a thing of the past. Whilst alcohol fuels are still being used in the U.S, castor based oils have not been used for years.

When using castor based oils in methanol fuelled engines the oil readily mixes with the fuel. Over rich mixtures not only result in excessive fuel dilution but also tend to wash the oil film from the cylinder walls resulting in a rapid increase in piston ring wear. Mineral oils do not have this problem, as alcohol cannot wash away the protective oil film. However a mixture of mineral and alcohol looks messy but the problem is only cosmetic, it still lubricates. It has been claimed that a methanol/castor mixture would be a safer lubricant than a combination of mineral oil and methanol, as it would be possible in the latter for slugs of fuel to be pumped into highly loaded areas resulting in drastic wear. This will not occur as the quantity of alcohol in the sump is small and the crankshaft and oil pump ensure that 100% mechanical mixing occurs and the fuel droplet size is therefore minimal. If such a problem could exist with alcohol/mineral mixtures then similar occurrences should happen with gasoline/castor but no one has yet to complain of this.

Another disadvantage with castor based lubricants is that modern chemical additive systems cannot be blended with them. All modern mineral oils are treated with anti-wear agents such as zinc dithiophosphate (ZDP) which dramatically reduces problems in the camshaft/cam follower high load area when compared with a non-zinc containing "synthetic" oil as proven in used oil analysis tests.

As earlier mentioned, castor is highly polar, but the film strength or load carrying capacity is much lower than a mineral oil treated with ZDP. Modern motor oils, with their vastly improved viscosity and anti-wear characteristics, will extend engine life to a marked degree. Competition engines of the 1920's and 30's had to be rebuilt at least once a year. The current combination of better materials, improved lubricants, oil and air filtration makes such annual rebuilds a thing of the past.

Mineral oils can be treated with dispersants and detergents, anti-rust agents, oxidation inhibitors, antifoam agents and corrosion inhibitors to improve internal engine cleanliness. None of these additives can damage components used in classic or vintage engines.

To summarise, the castor based material gave the best lubrication in its day. However, it is now a dated and long since superseded technology. Its use, although traditional, should no longer be contemplated. The only thing that castor can do that a mineral oil can't is to make the right smell in the exhaust.

Further details on these products are available on their respective product information sheets found on the Penrite web site: **www.penriteoil.com.au/products**

Penrite recommend **"The Right Oil for the Right Application"**

Click Here to visit the Penrite Recommendation Guide, which will ensure you receive the correct oil for your application

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