

# THE FUTURE FOR AUTOMOTIVE TWO-STROKE ENGINES (Part 2)

### CURRENT DEVELOPMENTS

In the previous issue of Lube, the origins and initial development of the 2T engine were described. The earlier engines, characterised by smoky exhausts and poor specific fuel economy, will be remembered by many of the older fraternity, as they provided motive power for many commuter lightweight motorcycles, mopeds and scooters in the prewar and postwar years. Many vehicle manufacturers in the UK used proprietary power units manufactured by specialist engine manufacturers such as Villiers, who dominated the market, although smaller engine suppliers included companies such as British Anzani. A number of other companies, including Scott, Associated Motorcycles, Excelsior and latterly Ariel also designed their own engines, use of which was restricted in the main to vehicles of their own manufacture. However, with the demise of the UK motorcycle industry, 2T engine developments, which have progressed steadily during subsequent years, have been largely attributable to overseas manufacturers with assistance from some UK specialist consultancy organizations such as Ricardos at Shoreham. These have included the Japanese 'big four' motorcycle manufacturers, Honda, Kawasaki, Suzuki and Yamaha, and closer to home, European car manufacturers such as Wartburg, Saab and DKW. This situation of steady if unspectacular development changed dramatically with the introduction of an entirely new approach to 2T engine design, namely the Orbital 2T engine. This power unit was enthusiastically seized upon by a number of vehicle manufacturers, notably Ford, who invested heavily in further developing what was confidently predicted to be the power unit of the future.

Dramatic predictions were made for the rapid uptake of the use of such engines, which, if realised, would have had major implications, both qualitatively and quantitatively, for the lubricants industry.

However, it was emphasised at this point that there were several possible variants of the Orbital principle, and the Ford engine was only one example. It would have been possible, for example, to use a more conventional wet-sump system, although some form of charge compression would be required as opposed to the use of the crankcase compression used in the conventional dry-sump 2T engines. 'Wet-sump' engines would possibly have required a rather different type of lubricant compared with the type of oil required in the "dry-sump" system envisaged for the Ford engine, although in many ways the lubricant requirements would have been similar for the two types of engine, e.g. in the reduction in the need for antiwear type additives due to the absence of valves and their associated operating systems.

### DRY SUMP SYSTEM

The oil pump delivers oil to reed valves of each cylinder.

Any oil draining into the crankcase is scavenged and returned to the oil reservoir.

Oil circulation through engine is high, nominally 70-80%.

The lubrication system dictated the use of rolling bearings rather than the more conventional plain bearings.

The lubrication system was essentially a "total loss" system, where all of the lubricant was eventually discharged into the environment.

### WET SUMP SYSTEM

Similar to a conventional four-stroke engine.

The oil is collected and retained in the sump.

The oil is pumped to connecting rods and bearings.

Bearings are of the conventional pressure-lubricated shell type of plain bearing.

The requirements of the lubricants by these two types of Orbital engine were summarised as follows:

### DRY SUMP

No valve train therefore no requirement for e.g. ZDDP anti-wear agents.

Diluent undesirable.

Low viscosity with high viscosity index. (SAE 5W/20?)

Synthetic-based formulation likely to be the preferred option.

Tendency for combustion chamber deposit formation would have required a low ash or ashless lubricant.

High temperatures require strong anti-oxidancy.

### WET SUMP

Again, no valve train therefore no requirement for e.g. ZDDP anti-wear agent.

Diluent unnecessary/undesirable.

Conventional base oil plus viscosity index-improver is possible (SAE 10/30?).

Polymer deposits may favour synthetic approach.

Tendency for combustion chamber deposits requires a low ash approach.

The conclusion was that, in spite of the substantial differences between the types of the Orbital engines described above, it may well have been possible to meet the requirements of both types of engine with a single lubricant, although the requirements of this lubricant would have been significantly different to those used in conventional four-stroke engines.

In spite of the total-loss lubrication system of the dry-sump engine, it was anticipated that there would have been a significant reduction in lubricant usage compared with the usage rates in conventional 4T engines of that period, which would have adversely affected lubricant volumes had this system been adopted.

Unfortunately for those who had invested heavily in the development of the Orbital engine, the rapid pace of engine development could not keep up with the even more rapid progress of the environmental legislators, who introduced a programme of mandatory emission control levels which even the more fuel efficient 4T gasoline and diesel engines were hard-pressed to meet, let alone the 2T, even in its Orbital guise. As a result, all of the earlier predictions of rapid uptake for this type of power unit were proved to be wildly optimistic.

However, in spite of this setback, the Perth-based Australian Orbital group continued to broaden its sphere of interests and currently provides a range of engine technologies for a broad range of applications including marine, recreation, motorcycle and automotive applications. The new technologies are known collectively as the Orbital Combustion Process (OCP) and use air-assisted, spray-guided direct fuel injection, lean burn combustion and electronic control systems to improve the performance of the combustion process. The main future of OCP technologies is considered to be associated with developments for the automotive 4T market. Last May, Orbital Engine Corporation gained the Chairman's Award in the Australian Technology Awards for its development of OCP for both 2T and 4T engine applications.

The Orbital 2T engine has now taken on a new lease of life with the technology developed both by themselves and by Synerject, the 50:50 tie-up between Orbital and Siemens Automotive, this new technology having now been adopted by four motorcycle producers.

Aprilia has already adopted the Orbital 2T engine in its latest SR50 DITECH sports scooter, which is claimed to offer fuel consumption benefits of some 40%, and reduction in oil usage by 60%. Since then they have introduced their Orbital-engined Scarabeo 50, claimed to be the first 2T scooter in the world to achieve the EURO 2 emissions standards without the benefit of a catalyst, which is remarkable indeed for a 'humble' 2T engine. See photographs of engine and graphic detailing lower emissions, fuel and oil consumption overleaf; engine and details refer to the DITECH 50 engine.

Peugeot Motorcycles, Europe's third largest motorcycle manufacturer, launched its innovative Looxor 50 TSDI model at the Paris Motor Show. On sale from early 2002, this model incorporates both Orbital's direct injection technology and Synerject's engine management system.

Sanyang, the Taiwanese automotive and motorcycle manufacturer and distributor, have released details of their SYM RS21 150 c.c. scooter, which claims 10% power increase, with 30% and 20% reductions in exhaust emissions and fuel consumption respectively compared with a conventional 4T carburetted engine. Sanyang now have an emission control system, which