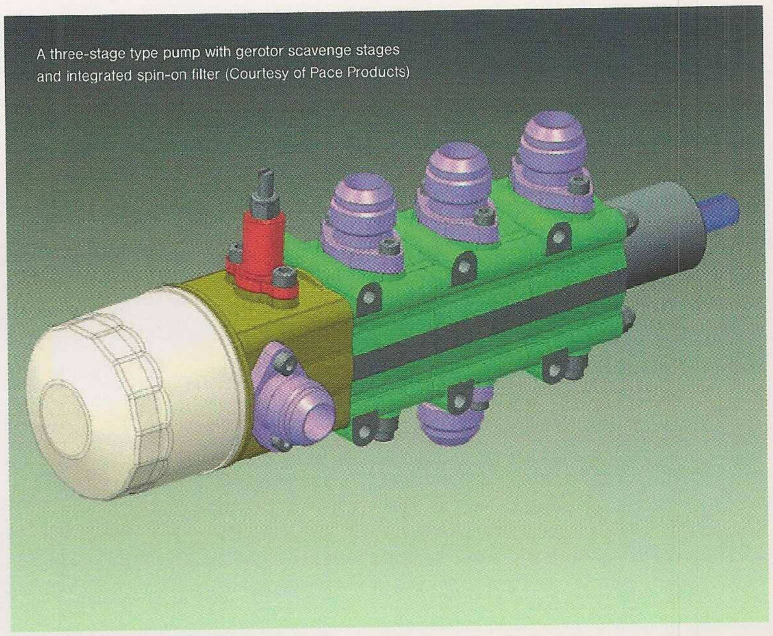
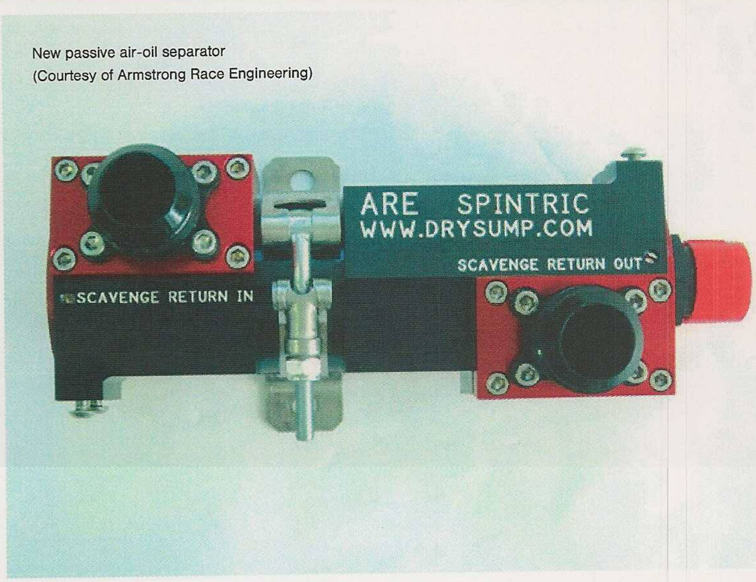
whole – indeed, a new oil pump designed for Porsche engines was discussed with one manufacturer during the research for this article. By providing a scavenge pick-up at the front of the engine to remove oil more effectively from the horizontally opposed configuration (notorious for trapping oil in the cylinder heads/blocks), the number of scavenge stages can be reduced.

While in its own right this pump configuration improves engine performance, providing crankcase vacuum estimated at a possible 8 hp gain otherwise unavailable with OEM equipment, its reduced length and packaging options also lead to the potential for other modifications. While engine capacity on the Porsche engines can be increased to 4.6 litres, the location of the oil pump has until now placed a limit on capacity, as it would interfere with the con rod if a longer stroke were to be adopted; with the revised aftermarket pump though, capacity can now be increased to as much as 5.0 litres.

Integration of components can also be highly beneficial to overall system weight. Some offerings are based around an integrated sump pan/oil pump, whereby the pump is built into the sump pan. While this cuts down on weight and volume, the original reason for its development was far more fundamental. Pumps that provide a very high scavenge volume (and hence desirable crankcase vacuum) can cause the feed hoses between sump and inlet port to collapse, particularly if the hoses have been weakened by kinking during installation or storage. By integrating the pump, the need for hoses was eliminated and the issue resolved. Installation and servicing is also simplified, with no risk of kinking hoses or otherwise damaging them, and the potential for failure or leaks at joints or connections reduced.

Integrating other components such as the oil filter can also help to simplify an installation, reduce overall system weight or reposition the filter to a more convenient location for that particular installation.


A three-stage type pump with gerotor scavenge stages and integrated spin-on filter (Courtesy of Pace Products)



New passive air-oil separator (Courtesy of Armstrong Race Engineering)

Air separation

The problem of oil aeration can be a significant issue: air can be entrained either during scavenging or as a result of pump cavitation, and in extreme cases leads to oil foaming. The presence of air in the oil decreases its lubricating and cooling capacity, possibly requiring higher oil pressures than would otherwise be needed to avoid bearing damage, and increasing the parasitic losses placed on the engine in providing a higher pressure.

By their nature, scavenge pumps draw in a quantity not only of oil but also air, in the process entraining air bubbles within the oil itself. Typically the oil is returned to the tank at the top, having only a short time to separate before being drawn out at the bottom. It is worth noting of course that oil tank design in itself will improve oil-air separation – to quote one manufacturer queried on this topic, "it is far from a simple beer can" – and a good oil tank design is often more than adequate to achieve separation.

However, in some cases only so much can be achieved within the oil tank, especially if a particular installation places a limit on tank size or configuration, so a more proactive approach to resolving oil aeration is needed. Typically this results in the use of a centrifugal air-oil separator incorporated into the pump as an additional stage. This spins the air-oil mixture, and the differing fluid densities encourage a radial separation of the two components, which are returned to the oil tank separately.

Recently though an alternative to a mechanical centrifuge for this task has emerged. Dubbed Spintric, the device is a passive (no moving parts) component in the oil system, so it does not impose a parasitic shaft loss or increase the bulk of the oil pump itself. The device can be placed in any dry-sump oil system, just before the tank return, and relies completely on the geometry of its internal passages to force the separation of oil and air, again using the principle of differing densities in a rotating flow.

While the precise internal geometry of this device is ▶

SOME EXAMPLES OF OIL PUMP & PAN MANUFACTURERS & SUPPLIERS

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obviously a trade secret, with work ongoing by the manufacturer to improve the trade-off between separation efficiency and the back pressure imposed, overall an estimated separation of about 60-70% is possible, with minimal losses. The internals are manufactured from nylon, which provides more than adequate heat resistance for very low weight, and is machined and ported to reduce flow losses. Most significantly, comments from some users about the device indicate dramatic reductions in oil temperature – as much as 30 F (15 C) – as the thermal conductivity of the oil is maintained through the oil cooler without excess air being present.

In particular, compared to a centrifugal separator, the Spintric system does not add an additional pump stage, which can prevent the use of any separation device in series such as NASCAR where the number of oil pump stages is limited.

Conclusions

The fundamental technology of oil pumps has remained largely the same over the past three to five years, with small gains being made in efficiency through manufacturing quality and the provision of cleaner operating conditions to allow tighter tolerances. It is evident though that larger overall powertrain improvements can be achieved in specific applications where the oil pump installation can be completely optimised, even if this means unusual drive or packaging solutions.

One of the most exciting developments uncovered in the research for this article is the use of new passive air-oil separation devices. These provide a double benefit to overall oil system design, permitting a faster flow of oil through the tank and potentially less complex baffle requirements, while eliminating the parasitic losses of a mechanically driven separation device. Further optimisation of such devices could be interesting indeed – if tank settling times can be reduced then they could lead to an improvement in oil cooling and a potential decrease in the total amount of oil required.

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