Tribological properties of bearing materials for automotive engines

Colin McAleese, Martin Repka, Osamu Ishigo

Daido Metal Co., Ltd – organizací složka, The European Technical Center, Brno, Czech Republic.

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Recent trends for automotive engines, both in Japan and Europe, show increased use of measures to improve the fuel-efficiency of vehicles. These are partly to comply with environmental legislation requiring reduction of the emissions of vehicles. Such measures include down-sizing, start-stop systems and hybrid vehicles. However, these measures can increase the severity of the operating conditions for plain bearings in the internal combustion engine.

Down-sizing of the engine in conjunction with turbochargers aims to have a smaller engine displacement, while maintaining the same power as conventional engines. The bearing size is reduced, so with the same power output the load on the bearings is higher. Improved load resistance of the bearings is therefore required.

Vehicles with start-stop systems use a much higher number of stop and start cycles than with conventional engines. While this improves the fuel economy of the vehicle, it also has a detrimental effect on the bearing. When the engine is switched off, the lubricating engine oil between the bearing and the shaft drains out, and direct contact can occur between the bearing and the shaft, which is when bearing wear is most likely to occur.

Bearings with resin overlays which show improved sliding properties in the boundary lubrication regimes were recently developed. This is important for the increased number of stop and start cycles which occur in recent engines. These polymeric overlays impart higher wear resistance and fatigue resistance when coated on aluminium based bearings when compared with conventional aluminium based bearings without the overlay, hence they can withstand an increased number of stop and start cycles.

The resin overlay is composed of solid lubricant dispersed in a polymer binder. Polyamide-imide was used as the binder because of its combination of mechanical, thermal and chemical resistance properties. Currently the work is focused on further improvement of the polymer overlay properties.

It was previously found that calcium carbonate particles maintain the wear resistance and improve the seizure resistance. This was confirmed by rig tests and engine bench tests as described in the article. In order to meet further requirements for wear resistance and higher load capacities, Daido Metal has developed a polymer overlay with hard particles which fulfils these demands.