Engine Oils and Additives

High-performing engine oil is essential to the smooth functioning of an engine. Engine oil comprises a base oil and additives. But there is concern, that future advanced platinum metals-containing emission control systems and catalysts on vehicles might be sensitive to and react adversely with some of the complex components in the oil.

The primary function of engine oil is to form and maintain a lubricating film between moving engine parts when subjected to high temperatures, mechanical stresses and contamination from 'condensate' and chemical compounds. It also helps to keep engine parts clean while the engine is creating soot, 'varnish', water and numerous deposit-forming substances. It must also seal areas between pistons, rings and cylinders to prevent gases escaping from the combustion chamber.

One of the most important properties of engine oil is its viscosity, that is, its resistance to flow. The Society of Automotive Engineers (SAE) has an internationally accepted classification system for grading oils according to their viscosity at various temperatures. The ability of an engine to start (crank) reliably on cold winter mornings depends largely on oil viscosity, as does preventing metal to metal contact at high temperatures. Friction, and therefore relative fuel consumption, are at their highest in the first few minutes of engine running, so thinner oils, which circulate more quickly around the engine, will lower the fuel consumption especially during start-up. Modern multigrade engine oils combine low- and high-temperature viscosity properties, so the same oil can be used all year round. Oils are graded with a number, for example, 5W-30; the first value, 5W (winter), is a measure of its cold temperature 'thinness', while the second value, 30, refers to its high-temperature properties and indicates oil thinness when hot, ascertaining it will not become too thin – so avoiding engine wear at prolonged high speed operation.

To enable multigrade oils to maintain their properties for long mileages a variety of additive packages are added to the base mineral/synthetic oil. These are mixtures of inorganic and/or organic compounds formulated to enhance specific properties of the oil. Examples of organic additives are: viscosity modifiers to reduce the rate of viscosity change with temperature, friction modifiers and dispersants to keep insoluble contaminants dispersed in the oil. Metallo-organic compounds, such as zinc dialkyl dithiophosphate (ZDDP), are used in the antiwear, antioxidant and corrosion inhibitor packages, while metallo-organic compounds of sodium, calcium and magnesium (among others) contribute to detergent packages to keep surfaces free from deposits.

The demands and thus stress on engine oils have become increasingly severe with the development of high performing modern engines. There is also demand for longer mileage periods between oil changes. Thus thinner oils with more complex additives and highly advanced base stock oils are necessary. Higher performance needs have usually been met by increasing the additive package, but tightening emission standards require more advanced emission control systems and catalysts on vehicles. These systems could be sensitive to additives, and there are particular concerns about levels of phosphorus, sulfur and ash (from detergents) in the additives. Phosphorus from the ZDDP antiwear package is a well-known catalyst poison, but while phosphorus levels have been reduced slightly, no effective replacement for ZDDP has been reported. Sulfur levels in oil may also become a concern now that sulfur is being reduced in fuel. Particulate filters for diesel vehicles are already in production and their use is expected to increase. Ash from the oil could block the filter and reduce engine performance.

Such issues are currently being discussed by the oil, additive and automotive industries aimed at defining suitable oils for the future. A. J. J. WILKINS

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