EVALUATION OF ADVANTAGES OF GTL SYNTHETIC DIESEL FUEL USING SPECTRAL ANALYSIS OF ENGINE CRANKCASE OIL

Yangiboyev Asilbek Ergash o‘g‘li, Doctoral student
Tashkent State Transport University, Tashkent

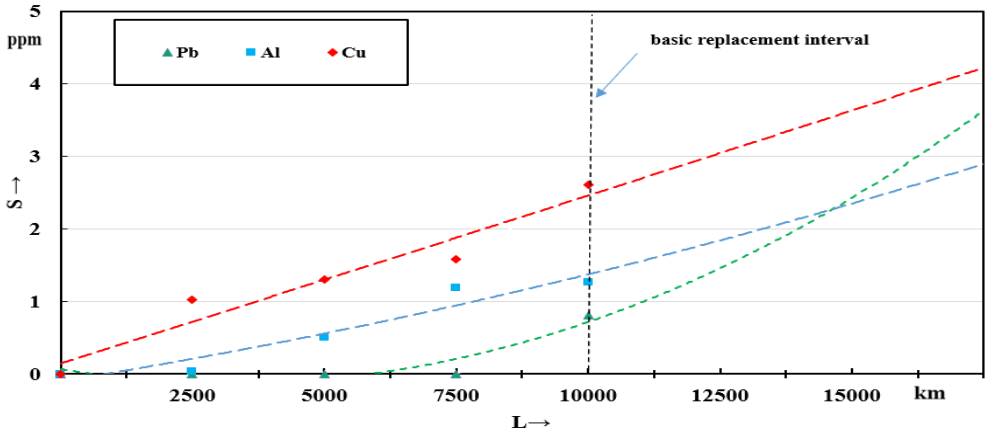
Abstract: In this study, the importance of spectral analysis and the advantages of GTL synthetic diesel fuel are highlighted. Based on the concentration of metals detected in the crankcase oil, it is possible to determine which engine components have experienced wear.

Key words: GTL synthetic diesel fuel, conventional diesel fuel, crankcase oil, wear metals, spectral analysis, engine diagnostics, environmental indicators.

In a time when environmental pollution is becoming a global problem, the use of alternative fuels, particularly synthetic diesel (GTL) and biodiesel fuels, is increasing. The near absence of sulfur and aromatic compounds in GTL synthetic fuel, along with its high cetane number, ensures more complete and stable combustion and reduces exhaust gas emissions [1]. The presence of sulfur compounds in fuel leads to the formation of aggressive acidic gases during combustion when combined with water [3].

Diagnosing the concentration of metals in crankcase oil through spectral analysis plays a crucial role in assessing engine condition. Determining the concentration of metallic elements in crankcase oil makes it possible to evaluate the wear of engine components. This method enables early detection of potential system faults without disassembling components. The purpose of spectrometric oil analysis is to monitor changes in lubricant composition, detect and track abnormal wear, and predict possible failures.

1-Table. Graph of metal concentrations during the use of synthetic GTL fuel



The results of this graph were obtained in accordance with GOST 20759 using an MFS-11 optical emission spectrometer. Engine oil samples were collected and analyzed at mileage intervals of 2500, 5000, 7500, and 10000 km from diesel engine crankcase oils. In this study Pb- indicates bearing wear, Cu- indicates wear of bearings and bronze bushings, Al- indicates piston wear. During our research, we compared the concentrations of other metal wear elements in crankcase oils of diesel engines operating on conventional diesel fuel with those using synthetic fuel. The aim is to evaluate the economic and environmental efficiency of synthetic fuel. The results show that wear of engine components occurs in both synthetic GTL and conventional diesel fuel operations. However, higher wear rates are observed when using conventional diesel fuel [1-Table]. GTL fuel, with its high cetane number and near-zero sulfur content, enables the engine oil to retain its operational properties for 20–30% longer. This, in turn, serves as a key factor in reducing maintenance costs and extending engine service life.

In particular, analyzing the dynamics of metallic elements using spectral methods is essential for practical diagnostics. Variations in metals such as Fe, Si, Cr, and Al in crankcase oil provide information about the condition of the cylinder-piston group, bearings, rings, and air filtration system. Regular spectral analysis of oil allows monitoring of the engine's internal condition before any failures occur.

Through spectral analysis, by comparing crankcase oil results from vehicles operating on GTL and conventional diesel fuels, it is possible to determine which engine components experience increased wear when using synthetic diesel fuel. The use of synthetic fuel leads to more complete combustion, reduced acidity, and a lower rate of oil oxidation. The extremely low sulfur content, reduced soot formation, and lower levels of toxic residues provide clear environmental advantages [2].

In general, spectral analysis is an effective and reliable method for diagnosing the technical condition of internal combustion engines, as the concentration of metallic elements allows identification of components undergoing wear.

References

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