PROMOTER OF IGNITION OF DIESEL FUELS

Trotsenko A.V., Grigorov A.B., doctor of technical sciences, associate professor
National Technical University «Kharkiv Polytechnic Institute»

It is known that the operational characteristics of the fuel play an important role in the stable operation of the diesel engine.One of the most important indicators of the quality of diesel fuel is flammability, which is determined in units of cetane number (CN). According to modern requirements for the quality of diesel fuels their CN should be in the range of 51-55 units [1].

At the same time, the oil refining industry produces diesel fractions with the CN which rarely exceeds 45 units.This can be explained by the shortage of high-quality hydrocarbons in Ukraine.Compensation for this difference is possible through the use in commercially diesel fuel cetane-boosting additives – ignition promoters [2].

The action of these additives is aimed at saving fuel and improving its environmental performance (reducing the toxicity of exhaust gases and their smoke), by increasing the completeness of its combustion in the diesel engine.

The mechanism of action of any ignition promoter is the easy thermal decomposition of its molecules by O-O, O-N or N-N bonds and the formation of reactive radicals.The energy consumed for this usually does not exceed 150 kJ/mol.

The formed radicals accelerate the oxidation of hydrocarbons of diesel fuel, which initiates their ignition. This improves the starting properties of diesel fuel, especially in winter.Another positive property of 1,3-diphenyltriazene is its ability to color the medium in which it dissolves. This property can be used in the production of branded varieties of diesel fuel.

Despite the wide range of ignition promoters currently used in diesel fuels, we propose to supplement this series with 1,3-diphenyltriazene (gross formula $C_{12}H_{11}N_3$).This substance belongs to the class of diazocompounds and has a high solubility in diesel fuels of various compositions.It also has pronounced anti-corrosion and antioxidant properties, which allows it to be considered as a multifunctional additive to diesel fuels. The effective concentration of the additive in diesel fuel is in the range from 0.5 to 1.0 wt. %.

The decomposition of the 1,3-diphenyltriazene molecule begins at a temperature of 130 °C according to the following scheme

$$C_6H_5\text{-}N{=}N\text{-}NH\text{-}C_6H_5 \xrightarrow{130\ ^\circ C} N_2 + C_6H_5^{\bullet} + {}^{\bullet}NHC_6H_5 \qquad (1)$$

Scheme (1) illustrates that the decomposition of 1,3-diphenyltriazene produces nitrogen, phenyl and aniline radicals.The phenyl radical is an unstable particle because its unpaired electron is not delocalized. It is characterized by increased reactivity and accelerates the oxidative reactions of diesel hydrocarbons.

Thus, 1,3-diphenyltriazene, due to its properties (thermal decomposition with the formation of reactive radicals) can be used as an ignition promoter for various types of diesel fuels.

References

1. G. K. Lilik and A. L. Boehman, Advanced diesel combustion of a high cetane number fuel with low hydrocarbon and carbon monoxide emissions. Energy & Fuels, 2011; 25(4): 1444–1456.
2. Fayyazbakhsh, A. and Pirouzfar, V. Investigating the influence of additives-fuel on diesel engine performance and emissions: Analytical modeling and experimental validation. Fuel, 2016; 171:167–177.