# DEPENDENCE OF DEPRESSANT ADDITIVE EFFICIENCY ON THE HYDROCARBON COMPOSITION OF DIESEL FUEL

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***Abstract:*** This study analyzes the influence of the hydrocarbon composition of diesel fuel on the efficiency of depressant additives. The effects of the content of n-paraffins, aromatic hydrocarbons, and naphthenic hydrocarbons on the low-temperature properties of diesel fuel were investigated. The research results demonstrated that the hydrocarbon composition of diesel fuel is a significant factor determining the effectiveness of depressant additives under low-temperature conditions.

***Keywords:*** diesel fuel, depressant additive, n-paraffin, copolymer, hydrocarbon composition.

At present, depressant additives demonstrate high efficiency in some diesel fuels, whereas in other types of fuels they may fail to provide the expected performance. This phenomenon can be explained by differences in the hydrocarbon composition formed during diesel fuel refining processes. The content of paraffinic, naphthenic, and aromatic hydrocarbons in diesel fuel directly affects the efficiency of depressant additives.

Analysis of studies conducted by the authors in [1] indicates that the effectiveness of depressant additives depends not only on their chemical nature, but also on the content of n-paraffins in diesel fuel and their molecular weight distribution. It is well known that diesel fuel mainly contains normal paraffinic hydrocarbons, which tend to crystallize at low temperatures. As a result, the filterability characteristics of the fuel deteriorate and the pour point increases.

In addition, diesel fuel contains isoparaffins, naphthenes, and aromatic hydrocarbons with different molecular structures, which significantly influence the

formation of paraffin crystals [2]. In particular, cyclic hydrocarbons and aromatic compounds with side chains can alter the mechanism of action of depressant additives. Such compounds affect the shape, size, and aggregation process of paraffin crystals, thereby determining the efficiency of additives in improving the low-temperature properties of diesel fuel.

According to the research results, when the concentration of n-paraffins in diesel fuel is within the range of 12-20%, an increase in the proportion of isoparaffinic-naphthenic and aromatic hydrocarbons leads to a decrease in the pour point. For example, when the n-paraffin content is 15% and the ratio of isoparaffinic-naphthenic to aromatic hydrocarbons is 1,5, the pour point decreases by approximately 15 °C, whereas at a ratio of 2,7 this value decreases up to 24 °C.

Furthermore, diesel fuels containing a high concentration of high-molecular-weight paraffinic hydrocarbons in the $C_{15}$-$C_{22}$ range exhibit the highest efficiency when copolymer-based depressant additives are applied. It was determined that an increase in the content of $C_{15}$-$C_{19}$ and $C_{19}$-$C_{22}$ n-paraffins from 3% to 9% results in an increase in the cold filter plugging point by approximately 6 °C and 18 °C, respectively.

In addition, the composition of aromatic hydrocarbons in diesel fuel is also considered an important factor influencing the efficiency of depressant additives. According to the results reported in [3], summer diesel fuels with a higher ratio of monocyclic aromatic hydrocarbons to bicyclic and polycyclic aromatic compounds are more sensitive to the action of depressant additives. At the same time, the highest efficiency of depressant additives was observed in diesel fuels containing a larger amount of monoaromatic hydrocarbons and low-molecular-weight n-paraffins.

The analysis showed that the hydrocarbon composition of diesel fuel has a significant influence on the efficiency of depressant additives. In particular, an increase in the concentration of n-paraffins deteriorates the low-temperature properties of diesel fuel, leading to an increase in both the cold filter plugging point and the pour point. An increase in the content of high-molecular-weight paraffinic

hydrocarbons in the $C_{15}$-$C_{22}$ range promotes the formation of larger paraffin crystals, which negatively affects the operational properties of diesel fuel.

At the same time, it was determined that an increase in the proportion of isoparaffinic, naphthenic, and monoaromatic hydrocarbons enhances the effectiveness of depressant additives. In particular, copolymer-based depressant additives demonstrated improved performance in systems containing high-molecular-weight n-paraffins. Moreover, in diesel fuels with a high content of monocyclic aromatic hydrocarbons, the application of depressant additives resulted in a significant reduction in both the pour point and the cold filter plugging temperature.

The obtained results indicate that a comprehensive analysis of the hydrocarbon composition of diesel fuel is of great importance when selecting depressant additives for diesel fuels.

The conducted analyses revealed that the hydrocarbon composition of diesel fuel directly affects the efficiency of depressant additives. In particular, the content of n-paraffins was found to play a key role in the formation of low-temperature properties. At the same time, an increase in the content of aromatic and naphthenic hydrocarbons was observed to enhance the effectiveness of depressant additives.

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